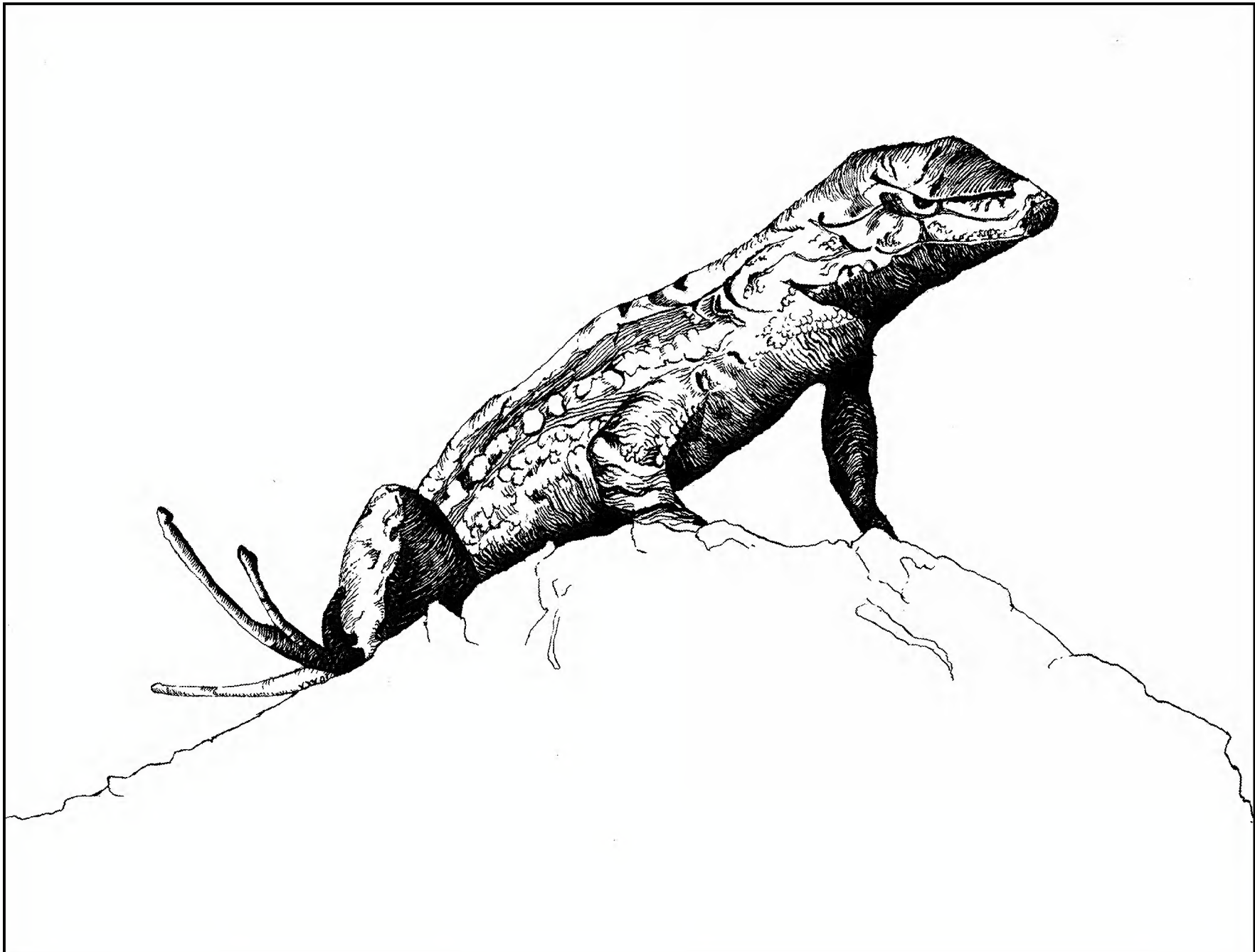

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BULLETIN OF THE CHICAGO HERPETOLOGICAL SOCIETY

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Environmental and Maternal Influences on Eggs and Hatchlings of the Eastern Fence Lizard (*Sceloporus undulatus*)¹

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Abstract

The objective of this research was to evaluate the relative importance of the incubation moisture environment, maternal yolk investment, and clutch to variation in phenotypes (i.e., body size, growth rate, running speed, thermal preference, and desiccation tolerance) and survival of hatchling eastern fence lizards (*Sceloporus undulatus*). An incubation experiment in the laboratory revealed that moisture conditions had little, if any, influence on hatchling phenotypes, but maternal yolk investment (i.e., yolk quantity) had a strong positive effect on hatchling body size. Clutch had a strong effect on all hatchling phenotypes that were measured suggesting the possibility of a genetic basis for phenotypic variation. A release-recapture experiment at a field site in southwest Virginia indicated that incubation moisture and maternal yolk investment had no significant influence on hatchling survivorship. However, clutch influenced hatchling survival through its effect on variation in two phenotypes – running speed and growth rate in the field. Clutches that produced hatchlings that ran relatively fast and grew relatively slow had greater survival than clutches that produced relatively slow runners and rapid growers. Overall, this study demonstrates the relative importance of clutch (maternal and/or genetic effects) to variation in phenotypes and survival of hatchling *S. undulatus*.

Introduction

Under natural conditions, reptile eggs experience substantial variation in incubation conditions. Natural nests vary greatly in mean and associated variances in temperature and moisture (Cagle et al., 1993). Such variation in conditions experienced during embryonic development affects various phenotypic traits of hatchling reptiles. For example, variation in incubation temperature and/or moisture can influence such features as body size, growth rate, thermal preferences, running speed, and the sex of the hatchlings (Burger et al., 1987; Werner, 1988; Janzen and Paukstis, 1991; Van Damme et al., 1992; Overall, 1994; Shine and Harlow, 1996). These incubation-induced phenotypes could subsequently influence the fitness of offspring (Vleck, 1988; Janzen, 1993; Downes and Shine, 1999; Andrews et al., 2000).

Moisture availability in nests is important for survival, metabolism, and growth of reptilian embryos (Cagle et al., 1993). Variation in nest moisture can also influence variation in hatchling body size. For example, relatively large hatchlings typically result from incubation in moist environments and relatively small hatchlings result from incubation in dry environments (Packard and Packard, 1988). Moreover, eggs placed in relatively wet substrates incubate for a longer period than those placed in relatively dry substrates (Gutzke and Packard, 1987; Phillips et al., 1990). Subsequently, both body size and incubation length could influence the survival of hatchlings

in the field (Vleck, 1988; Janzen, 1993; Andrews et al., 2000).

Various maternal and genetic effects are also important sources of phenotypic variation in hatchling reptiles. For example, the quantity and quality of yolk invested toward the developing embryo can have strong influences on certain phenotypic traits. Indeed, experimental manipulations on yolk quantity (and thus egg size) indicate that the amount of yolk within an egg has a positive effect on hatchling body size. This, in turn, can affect traits that are correlated with body size, such as running speed (Sinervo, 1990; Sinervo and Huey, 1990). Furthermore, significant inter-clutch variation suggests that phenotypes can be influenced either by maternal provisioning, or by the genetic contributions of both parents. Similar to environmental effects, maternal and genetic effects (i.e., clutch effects) can shape fitness-related phenotypes in ways that have important consequences on the survival and future reproductive success of hatchlings.

The purpose of this research was to determine the relative importance of incubation moisture conditions, maternal yolk investment, and clutch to variation in phenotypes and survival of hatchling lizards. I used a combination of laboratory and field experiments to investigate these environmental and maternal influences on eggs and hatchlings of the eastern fence lizard (*Sceloporus undulatus*) (Figure 1). This paper summarizes previously published work (Warner and Andrews, 2002a) and also presents results that have not been reported elsewhere.

1. This research was partially funded by the Chicago Herpetological Society. This paper summarizes previously published material and readers should consult the original publication for further details (Warner, D. A., and R. M. Andrews. 2002. Biological Journal of the Linnean Society 76:105-124). This paper was published with permission from Blackwell Publishing.

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Figure 1. Hatchling *Sceloporus undulatus* in Jefferson National Forest, Montgomery County, Virginia. Photograph by D. A. Warner.

Materials and Methods

Experimental design and protocols

Gravid female *S. undulatus* ($N = 28$) (Figure 2) were collected between 15 May and 26 June 1999 at a site in Jefferson National Forest near Blacksburg, Virginia (Montgomery County). Females were brought back to the laboratory and housed in a large enclosure that provided suitable areas for nesting. See Warner and Andrews (2002b) for a complete description of the enclosure.

Immediately after oviposition, eggs from each clutch were allocated into four incubation treatments. To evaluate the effect of incubation moisture conditions on hatchling phenotypes, some eggs were incubated under relatively wet moisture conditions (-150 kPa; wet treatment) and some eggs were incubated under relatively dry moisture conditions (-530 kPa; dry treatment). To evaluate the effect of yolk quantity on hatchling phenotypes, yolk was removed from some eggs with a sterile syringe and then these eggs were incubated at -150 kPa (yolk-removed treatment). As a result of yolk removal, egg mass was reduced by an average of 22%. In a fourth treatment, some eggs were punctured with a syringe and then incubated at -150 kPa (punctured treatment); this group of eggs was used as a control for the yolk-removed treatment.

All eggs were buried completely under vermiculite within individual glass jars (65 ml). Each jar was covered with clear plastic wrap sealed with a rubber band and then placed in a single environmental chamber set at a constant 28°C . To monitor water uptake by eggs, each egg was weighed regularly throughout incubation. For eggs in the dry treatment, vermiculite was changed if there was a decrease in egg mass. All other eggs were placed in fresh vermiculite approximately halfway through incubation.

Hatching occurred between 15 July and 29 August 1999. Immediately after hatching, I recorded the date, mass, snout-vent length (SVL), tail length (TL), and sex of each hatchling. Each hatchling was then given a unique toe clip for identification. Hatchlings were housed in plastic containers ($46\text{ cm} \times 24\text{ cm} \times 20\text{ cm}$), and provided areas for basking and retreat sites. Ten to fifteen hatchlings were housed in each container.



Figure 2. Female *Sceloporus undulatus* in Jefferson National Forest, Montgomery County, Virginia. Photograph by D. A. Warner.

Hatchlings were fed crickets, wax moth larvae, and flour beetle larvae and provided with water twice a day. Hatchlings were kept under these conditions for an average of nine days before they were released in the field.

During the nine days hatchlings were kept in captivity, I measured various performance traits of each hatchling. Thermal preference of each hatchling was measured at one to two days of age. Thermal preference was measured by placing hatchlings on a thigmo-thermal gradient and recording air temperatures (every ten minutes over one hour) at the locations selected by the hatchlings. Running speed of each hatchling was measured at three to four days of age. Running speed was measured by placing hatchlings on a 1-m-long electronically-timed racetrack and gently encouraging hatchlings to run by prodding them with a paintbrush. Running speed over four 25-cm intervals and a 1-m distance was measured 3 times for each individual. Running speed was evaluated as the fastest speed over 25-cm and 1-m distances. Desiccation tolerance of each hatchling was measured at six to seven days of age. Desiccation tolerance was measured as short-term evaporative water loss by placing hatchlings in a desiccator set at 0% relative humidity. Desiccation rate was analyzed as the change in body mass over 2 hours. Prior to release, I remeasured hatchling mass, SVL, and TL to obtain data on growth. For detailed descriptions of measurements of each performance trait, see Qualls and Andrews (1999) and Warner and Andrews (2002a).

All hatchlings ($N = 220$) were released at a site in Jefferson National Forest (Figure 3) between 24 July and 8 September 1999. The release site was a forest clearing characterized by large piles of woody debris, tree stumps, and fallen logs, which provided suitable habitat for hatchling *S. undulatus*. The area was surrounded by dense forest that acted as a natural boundary because hatchling *S. undulatus* typically do not disperse through the forest (Warner and Andrews, 2002a).

To obtain data on growth and survival in the field, the study site was searched for hatchlings about twice weekly from 31 July to 5 December 1999, and weekly from 5 March to 6 July 2000. After recapture, individuals were identified by their toe clip, weighed, measured (SVL and TL), and then released at their location of capture. Recapture success in this study was



Figure 3. Hatchling release site located in Jefferson National Forest, Montgomery County, Virginia. Photograph by D. A. Warner

comparable to that found in another study of *S. undulatus* where hatchlings were kept in an enclosed area (Niewiarowski and Roosenburg, 1993). Thus, I assumed the disappearances of hatchlings from the study site were due to death rather than dispersal (see Warner and Andrews [2002a] for details).

Data analysis

Puncturing eggs had no effect on any hatchling phenotype or survival (Warner, 2001). Therefore, individuals from the puncture treatment were included with individuals in the wet treatment for all analyses.

Comparisons of egg mass among the wet, dry, and yolk-removed treatments were made at 10, 20, 30, and 40 days of incubation with four separate Analyses of Covariance at each of these times; egg mass at oviposition was used as a covariate. A repeated measures analysis was not appropriate because hatching time differed among clutches. Thus, measurements of eggs from all clutches did not overlap perfectly at each time period. Sample sizes were too small for valid comparisons at day 50 because eggs had started to hatch by this time.

Analyses of Variance (ANOVA) and Covariance (ANCOVA) were used to evaluate the effects of incubation moisture, yolk removal, and clutch on incubation period, hatchling morphology, and performance. To evaluate the effect of incubation moisture conditions on hatchling phenotypes, hatchlings from the wet treatment (-150 kPa) were compared to hatchlings from the dry treatment (-530 kPa). To evaluate the effect of yolk-removal on hatchling phenotypes, hatchlings from the yolk-removed treatment (-150 kPa) were compared to hatchlings from the wet treatment (-150 kPa). Egg mass was used as a covariate when evaluating treatment and clutch effects on hatchling SVL and mass. Snout-vent length was used as a covariate when analyzing treatment and clutch effects on running speed. Growth was analyzed as a size-specific growth rate.

Monthly variation in hatchling and adult abundance (and activity) in the field was evaluated as the number of individuals captured per person hour of searching in the field. This analysis included both laboratory-hatched individuals and lizards hatched at the study site. Hatchling survival in the field was

evaluated at three different time periods regardless of release date; release date had no effect on survival (Warner, 2001; Warner and Andrews, 2003). Survival was evaluated at 6 weeks after release, 12 weeks after release, and to the following March 2000. The association of treatment and clutch with survival at each time period was determined by chi-square tests.

The association between phenotype and survival was evaluated in two different ways. First, data were pooled from all treatments and I made overall contrasts between survivors and non-survivors for each phenotypic trait at each time period (i.e., at 6 weeks, 12 weeks, and at March). Secondly, to evaluate the contribution of clutch to variation in survival, the relationship between percent survival for each clutch and clutch means for phenotypic traits was assessed with regression analysis. To avoid bias due to small clutches, only clutches with eight or more hatchlings were used in the clutch analyses. See Warner and Andrews (2002a) for more details about this clutch/survival analysis.

Results and Discussion

Egg incubation

All eggs increased in mass during incubation, but the relative amount of water uptake varied among incubation treatments (Figure 4). The rate of water uptake by eggs from the dry treatment was significantly slower than that of eggs from the wet treatment; by day 40 of incubation, eggs from the dry and wet treatments weighed 2.8 and 3.5 times heavier than their mass at oviposition, respectively. Other studies of moisture availability during incubation also indicate large differ-

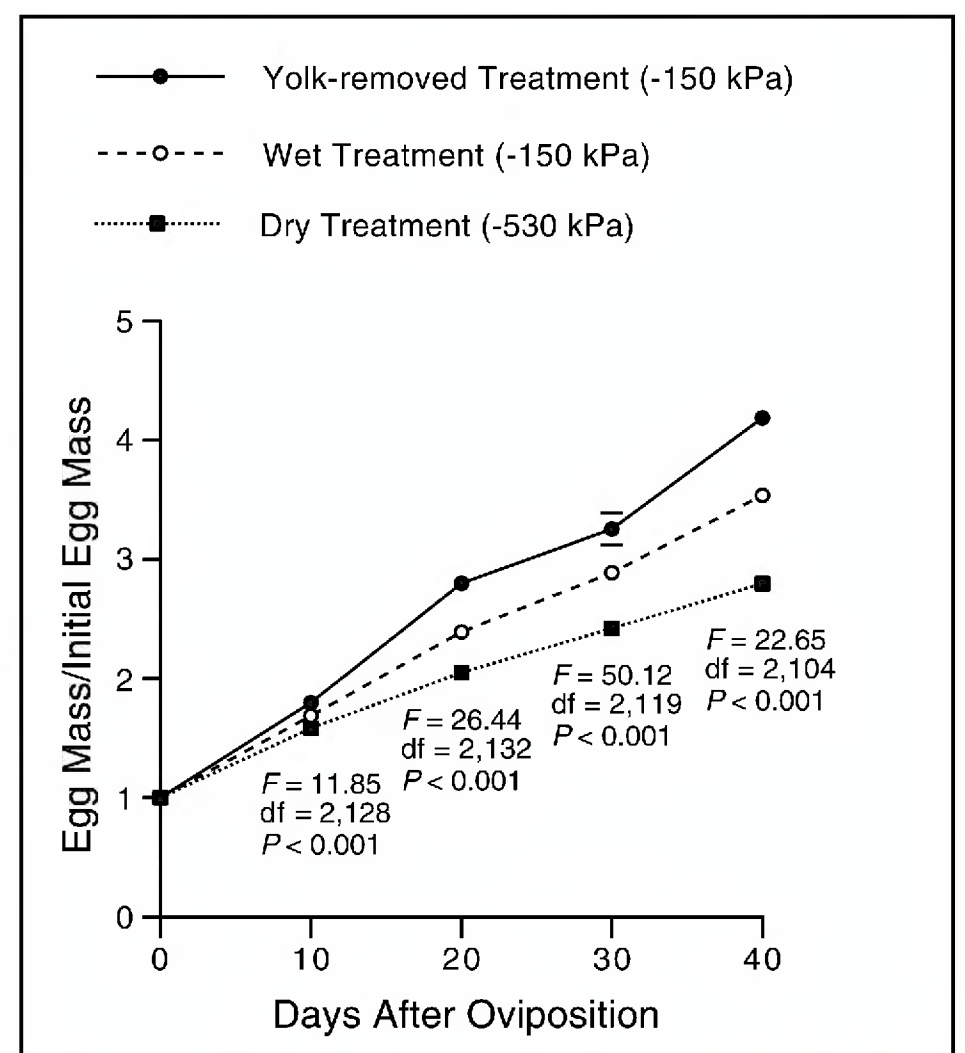


Figure 4. Water uptake by eggs during incubation expressed as the mass of the egg relative to its mass at oviposition (after yolk-removal for eggs from the yolk-removed treatment). Error bars represent 1 standard error.

ences in water uptake by eggs incubated in dry versus wet substrates (Tracy, 1980; Packard et al., 1980, 1985). However, eggs from the yolk-removed treatment gained more mass by day 40 than the other treatments despite similar moisture regimes to the wet treatment (-150 kPa). Eggs in the yolk-removed treatment were 4.2 times heavier at day 40 than their mass at oviposition (after yolk had been removed). Yolk removal presumably reduced pressure within the egg, thus allowing relatively rapid water uptake.

Overall, 222 of 269 eggs hatched (82% survival) and survival rates did not differ among treatments ($P > 0.317$). However, clutch had a strong effect on hatching success ($P = 0.016$). Incubation length was about 50 days for all treatments. Only two hatchlings died in the laboratory before release.

Effect of incubation moisture conditions on phenotypes

In general, incubation moisture had almost no effect on phenotypes of hatchlings. Snout-vent length and mass at hatching were the only traits that were significantly influenced by the experimental moisture treatments. However, differences in body size between hatchlings from the two moisture treatments were small despite large differences in water uptake by eggs between these two treatments. Hatchlings from the dry treatment were only 1.3% shorter in SVL and 2.3% lighter than those from the wet treatment (SVL: $P = 0.017$; mass: $P = 0.001$). Perhaps greater variation in moisture conditions would have increased variation in body size, but I suspect that moisture conditions drier than those used in this study (-530 kPa) would have increased egg mortality. Moreover, the small differences in size of hatchlings between the treatments was no longer significant at nine days after hatching prior to release in the field. Thus, for the effect of incubation moisture on hatchling body size to be ecologically meaningful, natural selection on body size would have to be intense during the first week after hatching.

Incubation moisture conditions did not influence variation in any other morphological or performance traits of the hatchlings. This result was not entirely surprising because several studies show that variation in incubation moisture levels do not have significant long-term effects on phenotypes of hatchling reptiles (Brooks et al., 1991; Bohn and Brooks, 1994), especially for some lizard species (Tracy, 1980; Flatt et al., 2001; Robbins and Warner, unpublished data). This does not mean, however, that the incubation environment is not an important source of phenotypic variation; incubation temperature has profound effects on many phenotypes of hatchling reptiles (Van Damme et al., 1992; Qualls and Andrews, 1999; Andrews et al., 2000).

Effect of yolk quantity on phenotypes

In contrast to moisture, yolk-removal had a strong effect on body size (Figure 5). Despite rapid water uptake by eggs in the yolk-removed treatment, hatchlings from this treatment, on average, were 7% shorter and 23% lighter than hatchlings from the wet treatment. The effect of yolk-removal on hatchling size persisted to nine days of age prior to release in the field.

Yolk-removal did not significantly influence variation in any

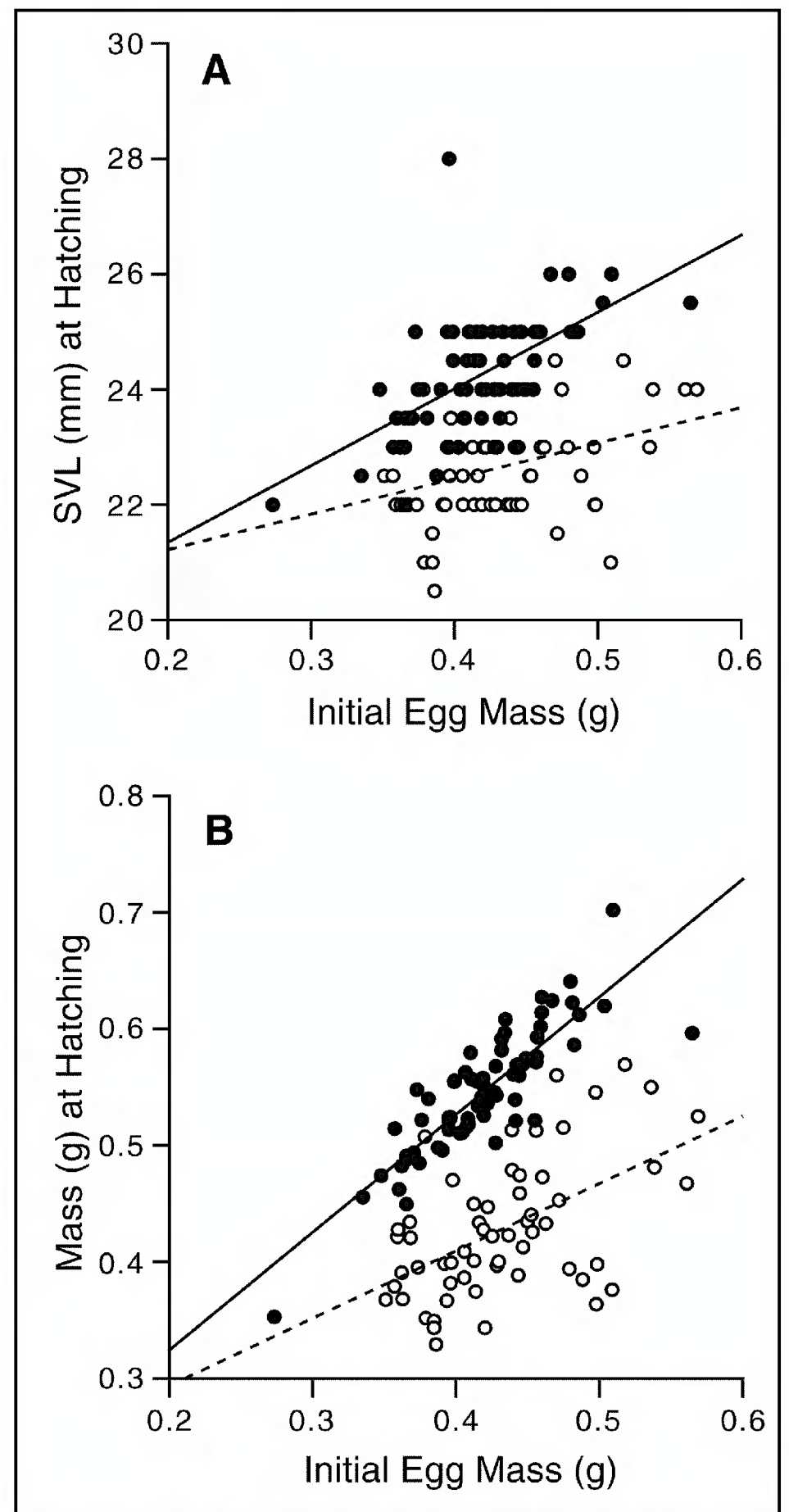


Figure 5. Relationship between egg mass at oviposition and hatchling body size at hatching for individuals from the wet treatment (-150 kPa) and the yolk-removed treatment (-150 kPa). A) Comparison of hatchling snout-vent length (SVL) between wet treatment (solid circles and line) and yolk-removed treatment (open circles and dashed line) (ANCOVA; $F_{1,84} = 150.2$, $P < 0.001$). B) Comparison of hatchling mass between wet treatment (solid circles and line) and yolk-removed treatment (open circles and dashed line) (ANCOVA; $F_{1,84} = 550.1$, $P < 0.001$).

other phenotypic trait either directly or indirectly. Running speed was not related to body size; the relatively small hatchlings from the yolk-removed treatment ran just as fast as the normal-sized hatchlings from the wet treatment. This result was unexpected because another study shows that size-manipulated hatchlings of *Sceloporus occidentalis* that were 10-30% lighter than normal ran significantly slower than their unmanipulated siblings (Sinervo and Huey, 1990).

Effect of clutch on phenotypes

Phenotypic variation among clutches greatly outweighed the

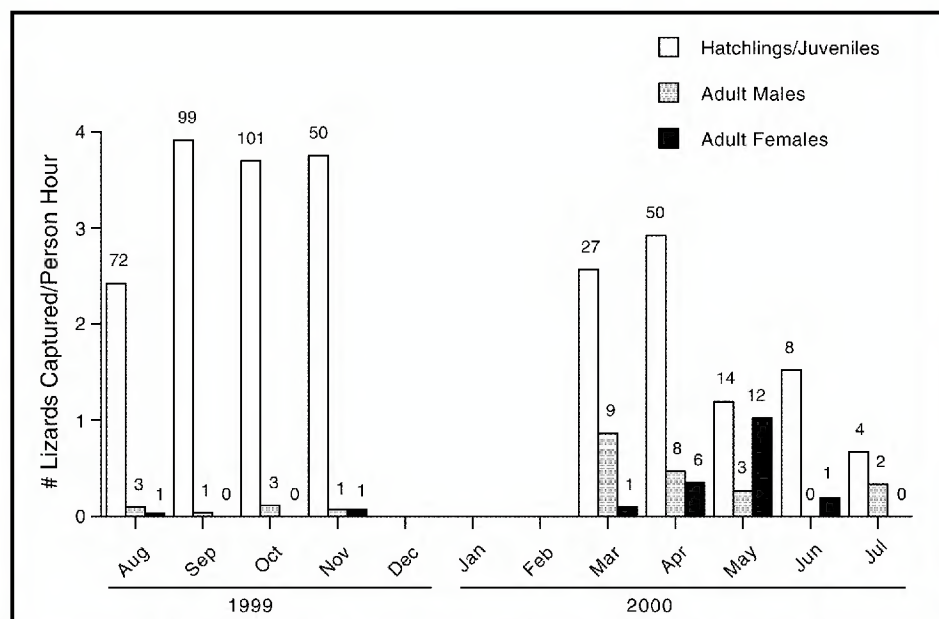


Figure 6. Monthly abundance of hatchlings and activity of adults at the study site as indexed by the number of individuals captured per person hour of searching in the field. Numbers above bars represent the absolute number of individuals captured.

variation among experimental treatments. Clutch had strong effects on most of the morphological and performance traits that I measured (See Warner and Andrews [2002a] for statistics). These results are consistent with many other studies that have examined inter-clutch variation in phenotypic traits (Van Berkum and Tsuji, 1987; Brooks et al., 1991; Bobyn and Brooks, 1994; Janzen et al., 1995; Shine et al., 1997).

Strong clutch effects on phenotypes should be interpreted carefully because significant inter-clutch variation could be due to various maternal effects (i.e., nutritional or hormonal influences on the embryo, size or age of the maternal parent, egg or clutch size, etc.), or genetic contributions by both parents. In this study, inter-clutch variation in phenotypes probably had some genetic basis because of the following reasons. Clutch had strong effects on hatchling body size even after statistically removing the effect of egg size (ANCOVA). Moreover, by removing yolk from some eggs, the effect of yolk quantity was essentially separated from the effect of genotype; clutch still had strong effects on phenotypic variation. However, I cannot rule out the possibility that variation in yolk quality (nutritional or hormonal content) influenced some of the variation that was found among clutches.

Survival in the field

Capture success of hatchlings was highest during months prior to winter when hatchlings were most abundant, and was relatively low after winter (Figure 6), probably due to a decrease in survival over time (Figure 7). Adult activity at the study site was highest in the spring and early summer 2000 when juvenile abundance was lowest (Figure 6). This pattern of adult activity is likely related to reproductive activities in the spring. During the spring and early summer, adult males are actively searching for females (Haenel et al., 2003) and adult females are searching for nesting sites. Female *S. undulatus* search for open forest clearings, such as my study site, to use as nesting grounds (Angeletta and Pringle, 2002).

Incubation moisture and yolk-removal had no significant effect on hatchling survival in the field at any time period (Figure 7). Although hatchlings from the wet treatment tended

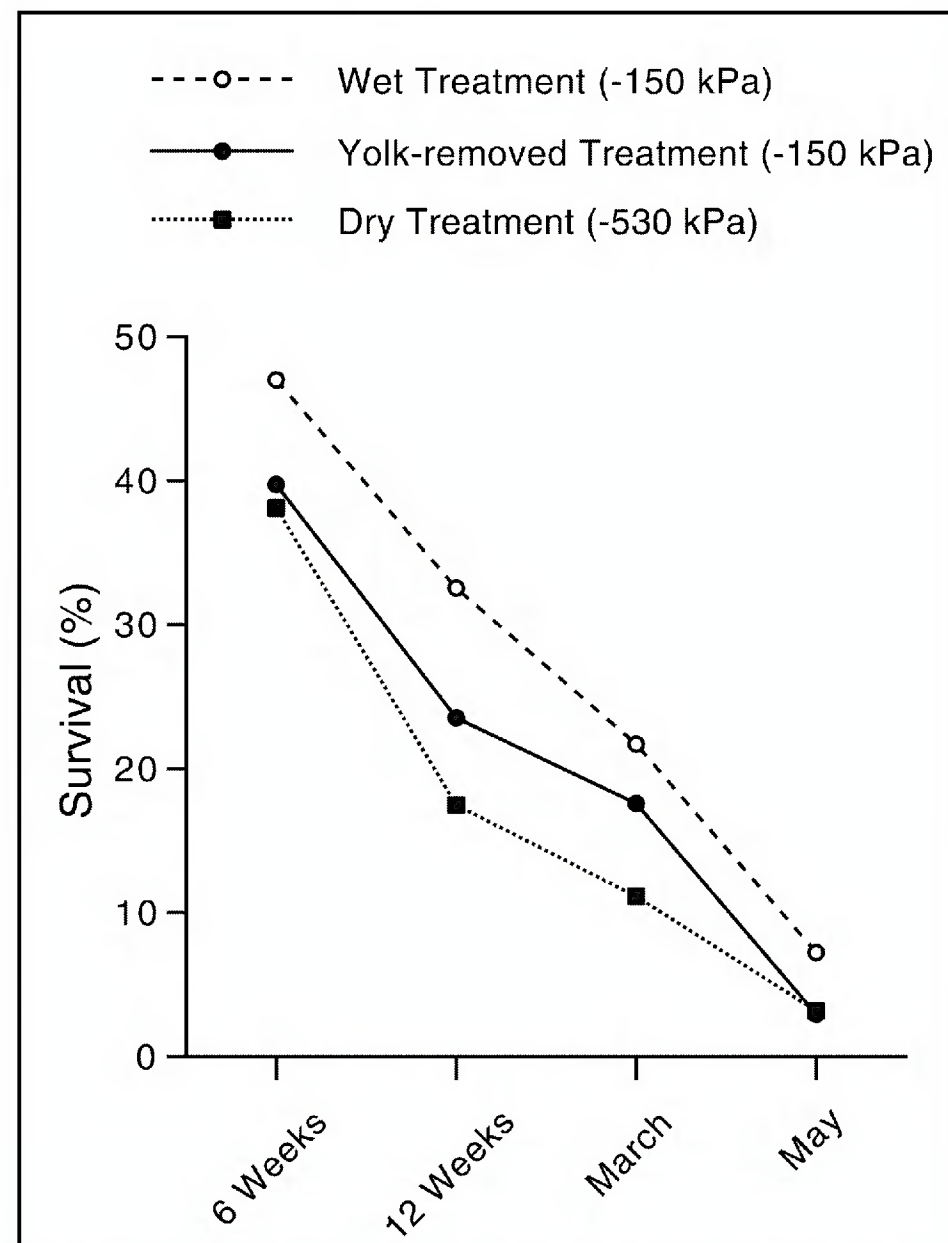


Figure 7. Survival of hatchlings in each treatment at each time period after release in the field. Recapture success did not differ significantly among treatments at any time period after release (chi-square tests, $P > 0.114$ for all). Recapture success in May was too low for valid statistical comparisons.

to have higher survival than hatchlings from the other treatments, these differences were not significant. In addition, clutch had no direct association with hatchling survival in the field. However, overall contrasts between survivors and non-survivors indicated that growth rate and running speed were important determinants of survival at each time period. Individuals that survived ran faster and grew slower than individuals that did not survive (Warner and Andrews, 2002a). It is important to note, however, that the overall contrasts between survivors and non-survivors may be biased because some clutches had a greater influence on the results than others as judged by the significant clutch effects on all phenotypes. With this consideration, the clutch survivorship analyses are more appropriate analyses than overall contrasts, and these indicated that clutch influenced survival through its effect on running speed and growth rate. Specifically, clutches with relatively high survival produced hatchlings that ran faster and grew slower than hatchlings from clutches with relatively low survival (Figure 8).

Ecological and evolutionary implications

The main objective of this research was to determine the basis for variation in phenotypes and survival of hatchling *S. undulatus*. Inter-clutch variation in phenotypes greatly outweighed variation produced by the experimental treatments. In fact, even the influences of incubation moisture and yolk quan-

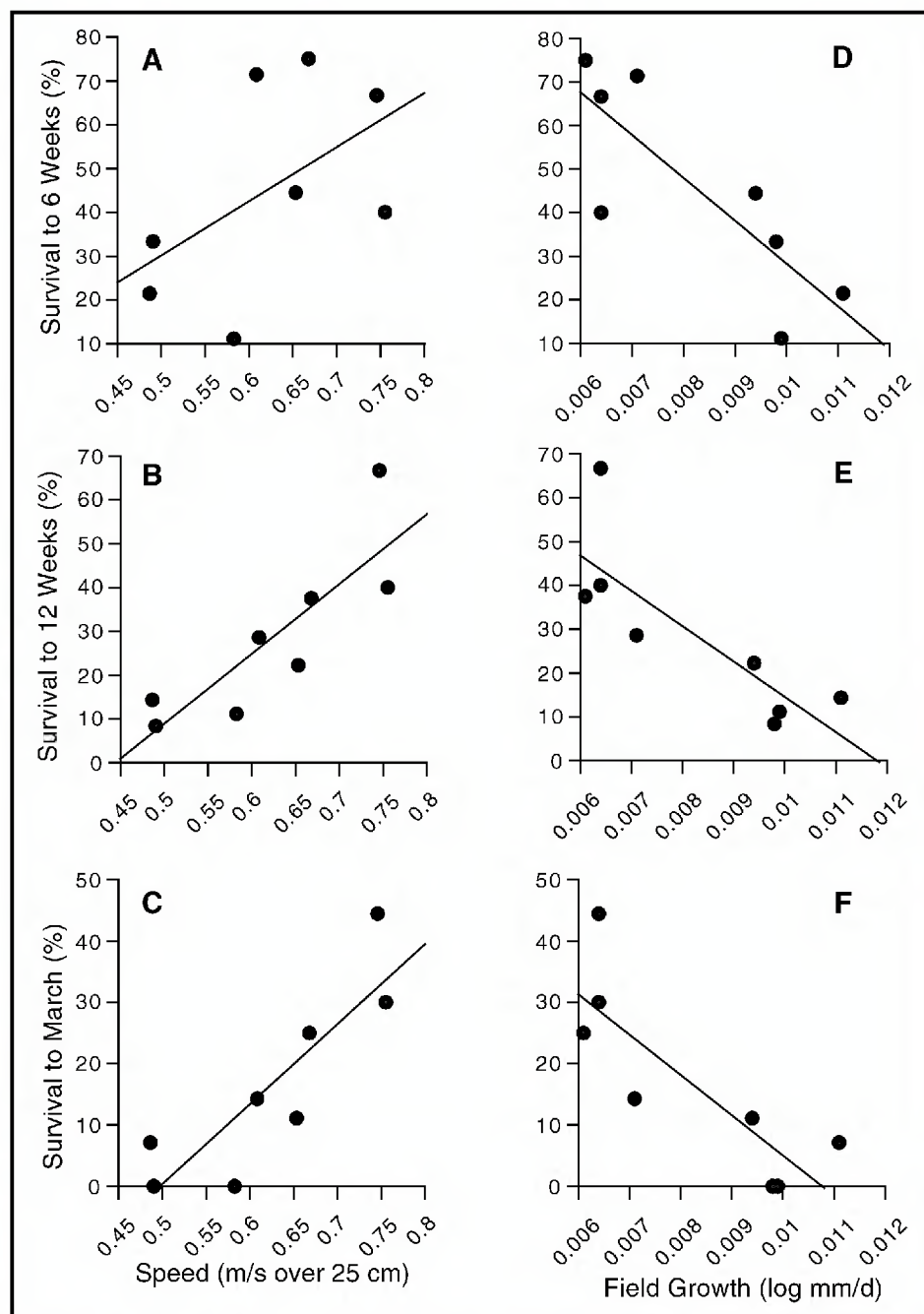


Figure 8. Relationships between running speed (left panel) and growth rate (right panel) with survival based on clutch mean values. A) Survival to 6 weeks versus running speed ($r = 0.534$, $P = 0.173$), B) Survival to 12 weeks versus running speed ($r = 0.845$, $P = 0.008$), C) Survival to March versus running speed ($r = 0.858$, $P = 0.006$), D) Survival to 6 weeks versus field growth rate ($r = -0.819$, $P = 0.013$), E) Survival to 12 weeks versus field growth rate ($r = -0.817$, $P = 0.013$), and F) Survival to March versus field growth rate ($r = -0.822$, $P = 0.012$).

tity on hatchling body size did not translate to long-term effects on survival. This result was surprising because it did not support the common hypothesis that “bigger is better” (Packard and Packard, 1988; Janzen, 1993). These results have two general explanations. First, bigger may not be better; small hatchlings may not necessarily have higher mortality than large hatchlings (Van Damme and Van Dooren, 1999). Secondly, the importance of body size may vary among years and populations (Sinervo et al., 1992; Forsman, 1993; Sinervo and DeNardo, 1996). In this study population, perhaps body size would have been associated with survival during a different year with different types of selective pressures. Nevertheless, these results still imply that the “bigger is better” hypothesis should not be assumed in all situations. The observation that body size manipulation through yolk removal did not affect hatchling survival suggests that, at least in some years, females could increase their fitness

through an increase in clutch size and a concomitant reduction in egg size (i.e., offspring body size).

The overall contrasts between survivors and non-survivors revealed that some phenotypes were indeed related to fitness (survival). Both running speed and growth rate in the field were important indicators of hatchling survival. More importantly, clutch was responsible for most of the variation in these two performance measures. Thus, clutches with high survival produced hatchlings with fast running speed and low growth rates in the field. Both running speed and growth rate are considered important measures of fitness. In accord with my results, fast running speed should be associated with high survival because fast runners are presumably more effective at capturing prey and evading predators than slow runners. On the other hand, the negative relationship between growth and survival is more complex. My results suggest that rapid growth may have associated costs (Forsman, 1993; Sorci et al., 1996). For example, to grow rapidly an individual must eat more than slow-growing individuals. Thus, if growth rate is positively associated with foraging activity, rapid growing individuals may suffer relatively high predation. Such relationships among growth, activity, and survival have been observed in other species of reptiles (Fox, 1978; Gerwien and John-Alder, 1992; Janzen, 1995; Lorenzon et al., 1999).

Overall, these results suggest that the influence of clutch on phenotypes is an important component of offspring fitness. I argue above that the clutch effects found in this study may reflect genetic influences of the parents. In order for certain traits to evolve within populations, these traits must be heritable, and thus have a genetic underpinning. An important point, however, is that even if variation in running speed and growth rate have a genetic basis, evolution toward fast speed and slow growth may not necessarily occur because the intensity and direction of selection can vary over time. Furthermore, survival is just a component of overall fitness. Although hatchling survival may mandate future reproductive success, future studies should monitor individuals to reproductive age to gain a better understanding of the long-term consequences of clutch on offspring fitness.

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Field Notes for *Varanus exanthematicus* in West Africa

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Specific location: Region surrounding the University of Ghana complex at Legon, just north-northwest of Accra (Figure 1).
All information accrued by the author and Mr. C. T. Banis.

29 October 1969. Purchased specimen from native who caught the lizard north of Legon (Figure 2). Total length 25½ in; tail only 12½ in. Very heavy-bodied and quite docile. Native volunteered information that lizard was caught under a bush in tall grass next to a termite mound. On 10 November 1969 this

individual laid a total of 27 eggs, two of which were broken during the process (Figure 3). Eggs were oval in shape, pearly white in color, and measured 1⅜ by ⅞ in. None adhered to each other.

30 October 1969. Young specimen obtained from northeast of Legon. Native had "chased it in tall grass." It measured 15½ inches total length; tail only 7½ inches.

10 November 1969. Young specimen obtained from just northwest of Legon. Total length 13½ inches; tail only 7¼ inches.

Our own sightings always took place in grassy fields with numerous bushes of various sizes and the occasional tall tree. We never did catch our own specimen, but “chased” plenty through the tangled brush.

Natives told us that this lizard often takes refuge in termite mounds. Such information was provided by several local hunters while we were extracting an adult ball python (*Python regius*) from a sizeable termitarium. However, these natives were quick to insist that “only smaller lizards” use the mounds; larger ones “don’t fit.”

The open air market at Accra, Ghana, offered a great variety of food items. Every color, every shape imaginable, could be purchased for the right price. In unison these often fresh, often well-done, items radiated a “nostril-teasing” aroma that also brought tears to one’s eyes. Now add a horde of pesky flies, open sewers, plus the stench of human sweat, and I give you a nightmare long to be remembered.

Many *Varanus exanthematicus* were offered for sale. Some still alive, others already dead. Living specimens were usually tied with twine, and either hanging from a makeshift shack, or contained in burlap sacks. We found neither juvenile nor very young *exanthematicus* for sale; only adults and subadults. In addition, no adult over 2½ feet was offered for sale during our visits. According to native hunters who did this for a meager living, this monitor was very common in the grassy fields near Legon and east of there.

Other reptilian delicacies found for sale in this market were ball pythons (*Python regius*), the occasional African rock python (*Python sebae*), Nile monitors (*Varanus niloticus*), and hinged tortoises (*Kinixys*)—just to mention a few.

We did not visit this market on a regular basis. Weather permitting, it was only operational once each week (usually on Saturday). Aside from that, it took at least one week for the nostrils to clear. However, each and every time we did attend, the same species were available. It is difficult to



Figure 2. Adult female savannah monitor, *Varanus exanthematicus*, from vicinity of Legon, Ghana. Photograph by Karl H. Switak.

imagine how much of this superb herpetological presence met a premature demise over a year’s period. Are we talking tonnage here?

Acknowledgments

The year 1969 marked my introduction to the “Continent That Spawned Adventure.” Most know it as Africa. A number of individuals contributed unselfishly to this fever from which I’ve never recovered. I herewith give credit to: the late Dr. Earl S. Herald (ichthyologist extraordinaire), Director of Steinhart Aquarium, California Academy of Sciences, San Francisco, California; Dr. Theodore J. Papenfuss, Museum of Vertebrate Zoology, University of California, Berkeley, California; Mr. Barry Hughes, Zoology Department, University of Ghana, Legon, Ghana; and Mr. Dennis Leston, Zoology Department, University of Ghana, Legon, Ghana.



Figure 1. West Africa: vicinity of Legon, Ghana. Habitat for savannah monitors, *Varanus exanthematicus*, ball pythons, *Python regius*, and gaboon vipers, *Bitis gabonica*. Photograph by Karl H. Switak.



Figure 3. Clutch of eggs from a savannah monitor, *Varanus exanthematicus* (see text for details). Photograph by Karl H. Switak.

Observations on the Rattlesnake *Crotalus atrox* by Berlandier 1829–1851

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Abstract

Notes recorded by Jean Louis Berlandier during his residence in Matamoros, Tamaulipas, Mexico, 1829–1851, about his experiences and observations on *Crotalus atrox*, are reviewed for their historical interest.

Jean Louis Berlandier (1803–1851) was a brilliant young French botanist, trained by the great Auguste-Pyrame DeCandolle. Eager for new species to describe, DeCandolle arranged for Berlandier at the age of about 23 (his birth date is uncertain) to accompany a French commission designated to explore the boundary between Mexico and the United States. His duty was to collect plants and send them back for DeCandolle to study.

This he did, as the commission explored the northeastern states of Mexico, and the southern and southeastern parts of Texas. Berlandier was an indefatigable collector, and sent huge quantities of biological material, mostly plants, back to DeCandolle during the years 1827 to 1829. Inexplicably, DeCandolle was dissatisfied with the collections he received, and accused Berlandier of being lazy and wasting funds. Berlandier was devastated by the totally unjustified criticism, and refused to return to France with the commission. He took up residence in Matamoros, Tamaulipas, where he lived the rest of his life and became an honored leader.

Although totally isolated from any centers of learning, Berlandier was an inspired naturalist, and wrote an incredible volume of manuscripts on a wide variety of natural history topics (see Rosenzweig, 2003). During his lifetime he only published, in 1850, a summary of the travels of the Boundary Commission, to which he appended a partial list of the amphibians and reptiles of Tamaulipas. Since his death a number of books have been published based on his manuscripts, which are now divided among the Smithsonian Institution (see Rosenzweig, 2003), Huntington Library, Harvard, Yale and Texas. A sizeable manuscript on the amphibians and reptiles of Tamaulipas, mostly in French, partly in Latin, is in the Smithsonian Institution. We obtained a photocopy several years ago. Mostly it consists of lengthy descriptions of various herps, and we have recorded their identities elsewhere, along with some of the brief notes on the natural history of the described animals (Smith et al., in prep.). One account, for *Crotalus atrox* (which was erroneously named "*Crotalus horridus* Linn." in the manuscript), was exceptionally lengthy, and included much more information about it than for any other species.

That account is of considerable interest historically, representing the knowledge and folklore about the species as of that time and place. We here provide a translation and commentary on it, using the proper name for the snake in lieu of the consistent appearance of the name *Crotalus horridus*. The translation

below is from an unpublished manuscript by Dr. Caleb B. R. Kennerly, written sometime between 1853, when Berlandier's manuscripts were purchased from his widow (by Lt. Darius Nash Couch), and 1861, when Kennerly died. The original of the translation is now in the possession of Kraig Adler through the generosity of RC. A critical analysis follows the translation.

"Habits. This snake, notwithstanding that so much has been written about it, deserves yet the attention of naturalists. Its habits have been but slightly or poorly studied, and as has been very well said by Sonnini, '*on a craint de voir le crotale et on l'a mal vu*' [looking upon the rattlesnake with fear causes us to view it badly]. Some authors have ascribed to it great rapidity of movement, and say that in the twinkling of an eye it coils itself in a circle, resting on its tail, and precipitates itself like a released spring, violently striking its prey.

"These movements are common to most serpents, but are completely wanting in *Crotalus atrox*; very fortunately it is not active, and sometimes even quite sluggish. Men and animals are wounded by this dangerous reptile when it is taken by surprise and cannot escape — its first object when it hears a noise. I have often passed very near them when they were asleep, without perceiving them, and only been aware of their presence when, surprised, they endeavored to escape, making a noise with their rattles.

"I have often encountered them in Texas, and especially in the state of Tamaulipas. When they are asleep they are coiled in a circle, but the head and part of the body are always found free, reposing on the coil in order to be better prepared at the first alarm. In May 1847 one of my friends and I observed a male and female thus coiled up on one of the islands of the Laguna Madre, and had enough time to hunt for sticks to kill them. When we first perceived them they were so near, hardly a foot distant, that, had they been alert and active, as are most other reptiles, we would certainly have been bitten.

"Activity of the Poison. During the winter these snakes conceal themselves underground, and fall into a lethargic state, only to reappear in the spring. It is generally upon emergence that it sheds its skin, and is then clothed in its most beautiful colors. But it is at this time also that its venom is most effective. Isolated examples of these facts I had heard of from time to time, but they were presented to my own observation during the war with the United States.

"Toward the end of February, during a reconnaissance that

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General Mejía made on the other side [north] of the Río Bravo, south of the Colorado, while camped in the middle of a soggy plain, one of these animals, struck from under a cannon a dog belonging to the gunner. The animal uttered only one cry, made single bound from the spot, and fell to the ground, immediately dead. This fact passed under my own eyes. The dog had been bitten under the neck. Two days later, when passing over the same route, I found that the wounded parts had become gangrenous and sanious (having a discharge of pus and serum), and that the birds of prey had not attacked the intestines, as is their custom, but had contented themselves devouring the posterior extremities.

“Later, in May of the same year, two or three days before the battle of Palo Alto, in the Mexican camp of the same name, a sutler was bitten on the buttocks by a *C. atrox*, and died almost instantly notwithstanding the care of the surgeons, particularly Mr. Humphrey, who immediately employed ammonia, both internally and externally.

“From these observations, and several others of like nature, we may conclude that the venom of the rattlesnake has a very rapid action during the spring. It appears that that which accumulates during their lethargic state of several months is instantaneously mortal. Afterwards, although mortal, its action is less violent, and permits medical treatment which more often cures the wounds.

“**Remedies.** Without citing here the vaunted properties of Mikania Guajo, and the therapeutic means recorded in the works on medicine, I may say that I have always produced a cure otherwise. I employed ammonia as a liniment externally, and mixed with warm, soporific drinks taken internally. This was preceded, according to circumstances, by scarification. Local bleeding by means of leeches or, better still, scarification and cupping glasses is an indispensable treatment when gangrene occurs, a circumstance which almost always accompanies these bites. During a residence of more than 20 years in the regions where these reptiles are extremely common, I can, from long experience, vouch for what I have said.

“Passing over these remedies more or less known to physicians, we turn our attention to those empirical remedies employed by the people who live in the same area as these formidable reptiles. It is to be hoped that their experience may be of service to mankind in preventing the misfortunes so often caused by these snakes.

“Amongst the preservatives or preventatives and remedies, there is one which has always attracted my attention. I refer to the use of the gall of these same animals. All the people of the area, even the Indians, assure me that when bitten it is only necessary to drink immediately some of this substance, mixed with a little water. That being done, the bite is of little consequence. They assure me that persons who repeat this precaution, that is, who drink this substance every six or eight years, are not affected at all by the bites of rattlesnakes. I have known a great many persons in these areas who practice this custom, and who even use it with their children. They assured me that although they had been bitten several times, they had used no other remedy. Those who do not take this drink as a

preventative all have the habit of carrying continually with them a dried bladder of gall. At the moment of an accident they prepare a mixture of it with warm water. If they happen not to have one of these bladders at the time of a bite, they generally use the one of the animal that caused the bite. All of the people living in these rattlesnake-infested areas perfectly agree in these remarkable facts, which I submit to observers.

“It is, however, important to remember in procuring the gall of these animals that they must be killed at once, with a single blow, not allowing them to fight back. The properties of the gall in bite treatment are destroyed or much less active if the snake is irritated before it is killed.

“I have seen also a remedy used by the soldiers of the forts, which seemed to produce an excellent effect. But never having examined the depth of the wound, it is difficult for me to judge the degree of its utility. I have seen a bite which, after a cataplasm [poultice] of the snake’s head, well ground between two stones, had been applied for 24 hours, appeared merely as a sore.

“I have instituted some experiments in order to convince myself of the degree of confidence to be placed in these empirical remedies, and will hereafter publish the results.

“**Generation.** *C. atrox* copulates in the spring some days after it has moulted its skin, when its colors are most brilliant. At this time they are always found in pairs.

“The female at some later time brings forth its young alive. They endeavor to bite as soon as they are born. I have seen those that were squeezed out of a dead snake bite at everything placed before them. I do not know whether at this tender age they are venomous, but I am convinced that their teeth have acquired only a very feeble consistency.

“At the first birth the female brings forth only 18 or 20 young ones, but those females that have brought forth several times give birth to 50 or 60.

“**Fascination.** It is impossible to mention this snake without saying something of its pretended faculty of fascination or of charming the animals of which it makes a prey. I believe nothing of a great number of tales told in reference to this subject, but I do believe it is something more than fright or fear that they inspire in these animals.

“A fact that I have observed in my leisure is the following: when the snake hunts a small quadruped or bird, it does not flee. Such is the case particularly with rats, rabbits and hares, even though they are active. I have seen a hare, which might have escaped, instead hop within two or three paces in front of the reptile, approaching it with uneasiness and fright and with irregular movements. Persons who were present at the time frightened the snake, but the hare did not move until the snake had disappeared. Birds do the same thing, after uttering plaintive cries.

“**Enemies of *C. atrox*.** If the rattlesnake is an enemy to man and a great many animals, it also has its own foes, no less formidable. The principal one is a small pheasant (*Geococcyx viaticus*) [roadrunner, *Geococcyx californicus*] of the areas

which it inhabits, and a large black snake [*Drymarchon corais erebennus*] which lives in moist and swampy places, and which the people respect for this reason.

“It is an interesting combat between the roadrunner and the rattlesnake, the former always being victorious. As soon as the bird perceives one of these reptiles, it does not seek to escape, but on the contrary prepares itself for an encounter. Endowed with extraordinary agility and being able to run with great speed, though capable of only moderate flight, it approaches its enemy with outstretched wings. The snake, striking at the wing feathers, receives a very severe blow to the head by the bird’s bill. This action continues until the snake appears to be dead. Neither of the combatants appears to try to escape.

“The other enemy, not less formidable, is the black snake of which I have spoken, and which I believe I have described under the name of *Coluber pullivorus* [*Drymarchon corais erebennus*]. When the rattlesnake perceives it, it shows great fear. Sometimes it lies perfectly still, and at other times it is agitated and frightened. The black snake advances, and precipitates itself upon its enemy, sometimes twisting around it, then falling upon and beating its head. The whole operation often lasts several hours. When the rattlesnake has been thoroughly battered, the black snake uncoils itself, and rejects totally the body of its enemy, which it never eats.

“The fear inspired in the rattlesnake by the black snake is so well known throughout the country that persons forced to sleep on the ground in open country place around their beds a large black rope, from which the rattlesnake flies, believing it to be its enemy.

“**Story of the Rattlesnake.** There are a great many stories, more or less ridiculous, told of these reptiles in the areas where they are found.

“It is quite a common belief that the rattlesnake, when it goes to drink, disposes of its venom by placing it on some hard surface, taking it up again as soon as it has finished. If its venom is carried away and concealed, so the inhabitants say, so the snake cannot find it, the snake kills itself in despair. Whoever examines the poison apparatus will see the absurdity of this belief, which does not even merit refutation.

“**The Fangs.** The inhabitants of the areas where the rattlesnake is found have singular ideas about its fangs. It is a common belief amongst them, and one which appears to me to be well founded, that these teeth are deciduous and are replaced every year. But that which seems to me to be incomprehensible is the belief that the fangs which are lost by accident, or naturally, are deposited in a sac where they are destined for replacement. Having examined several heads of crotali of different sizes, I am convinced of the following facts.

“All rattlesnakes, whatever be their age, are furnished, underneath the venom sac and a little behind it, a sac filled with teeth. I have not been able to satisfy myself whether or not at each moulting the fang of the previous year falls, but it is certain that I have never encountered one of these reptiles without fangs. If they fall naturally, I am inclined to believe it takes place during their state of lethargy, for in the springs they

are always provided with large ones. If one or both are broken by accident, it is also certain that in a short time their place is supplied with new ones.

“In examining carefully one of these fang sacs, I have found from 14 to 18 teeth in an adult reptile of large size. These teeth are placed one behind the other, diminishing gradually in size and consistency. The first may be very firm, and entirely resemble those of which the animal makes use. The last is very small, totally rudimentary and reduced to a mucilaginous mass without consistency, but preserving completely the form of that organ. The intermediate teeth present all of the grades between these two extremes. After these observations, it will be perceived that it is not prudent to trust one of these reptiles that has had its fangs extracted, since they are replaced so easily.”

Commentary and Analysis

This account by Berlandier is important for four overlapping reasons: (1) his writing represents the visions and beliefs of his time and place, thus giving us a word picture of historical interest; (2) this word picture takes on greater value if it is compared with older and more recent accounts, so that we can observe the progress of scientific methodologies and the accretion of knowledge; (3) Berlandier’s writing allows us to see how very far we have come, in some respects, thereby giving us justifiable pride in our current understandings, although on the contrary, it makes us realize how little we have learned in other respects; and (4) Berlandier might also give us pause to wonder if any of our current understandings, though perhaps strongly held, are as shaky as some of his turned out to be.

Consider one of Berlandier’s initial remarks, that “its habits have been but slightly or poorly studied.” This was undeniably true in his time; but, is the situation greatly different today? Certainly we know much more about the natural history of *C. atrox* than did Berlandier (e.g., see Campbell and Lamar, 1989; Ernst, 1992), but the present authors doubt that any herpetologist would say that we know all that should be known, or that we know enough to write a thorough account of this snake’s evolution, geographical range, and the ecological and behavioral variations occurring within that range. This being the case, perhaps some of our understandings of *C. atrox* might be no less flawed than were some of Berlandier’s views.

Berlandier noted that other authors had reported great rapidity of movement of *C. atrox*, coiling “in the twinkling of an eye,” and striking “like a released spring.” On the contrary, he described such movements as “completely wanting . . . even quite sluggish.” He went on to describe instances in which the snakes made little or no movement when inadvertently encountered, and certainly locomotion is usually much slower than in most other snakes. Why Berlandier did not acknowledge the very rapid defensive movements when *C. atrox* is aroused is uncertain; the behavior he described occurs under suboptimal thermal conditions.

We agree completely with Berlandier that *C. atrox* is especially dangerous when surprised and cornered. An additional point, however, is that numerous bites occur when people

handle this snake, not only blocking escape, but also inadvertently simulating the actions of a closing predator. Perhaps this sort of thing happens more commonly in our time than it did during Berlandier's day.

The section on the actions of venom in the spring represents a variation on a belief that has long been widespread about many species of rattlesnake. Any interested reader should consult Klauber (1972) for an excellent discussion of the history and diversity of beliefs about temporal variation in venom toxicity, where you will learn that speculation along these lines goes back at least to Gaius Plinius Caecilius Secundus (61–113 AD) and was common in Europe prior to Columbus. Most interesting is the fact that as many people believed venom to be more dangerous in the summer as believed the toxicity to be higher in the spring. Klauber suggested that the underlying cause of temporal variation in dangerousness of the bite was probably variation in the supply of venom available to the snake rather than any variation in its chemical composition.

Perhaps the most interesting aspect of this section of Berlandier's manuscript is his vulnerability to certain anecdotes, although he repeatedly cautioned against acceptance of unsubstantiated folklore. In his own way he was critical and independent, but where he had no observations of his own he merely reported common superstitions.

Particularly notable was the unfortunate sutler who was struck on the buttocks and treated (not by Berlandier) with ammonia, "both internally and externally." Perhaps this man's death was more effected by the cure than by the envenomation. On the other hand, in this context Berlandier voiced a long-standing belief (since 1738) in the efficacy of ammonia as a treatment for rattlesnake bite. Klauber (1972: 892) recorded that in the 1890s "a new and certain cure for rattlesnake bite was announced" — ammonia. After that announcement, Klauber carried a bottle of ammonia with him in the field, confident that he had "sure protection" from rattlesnake bite. Ammonia actually had been shown to be ineffective against snakebite as early as 1765, according to Klauber.

In the use of scarification, suction and blood-letting (by leeches), Berlandier was exploring some of the mechanical treatments of snakebite that were found to be efficacious before antivenin was available.

One of the remedies mentioned deserves special notice, this being the use of the snake's gall (bile). Here we again refer readers to Klauber (1972) for a treatment of "cures derived from the snake." He begins with this sentence: "One of the more persistent tenets of folklore medicine is that the cause of an injury will also furnish the cure, if the method of application can only be discovered" (p. 907); and, his first reference is to Aristotle's assertions about using the body of the asp to treat

envenomations! In all likelihood, Berlandier was simply encountering ideas brought by Europeans to the New World, and diffused widely among native Americans; he then "discovered" and thought them to be new or indigenous. The point Klauber would make is that a herpetologist needs to be part anthropologist in order to recognize when he is being hoisted with his own culture's petard.

Mating generally occurs in the spring, so Berlandier was correct about this aspect of *C. atrox* phenology, but additional matings in August have been reported in Arizona and probably also occur in Mexico. Similarly, male attendance of potential mates has been reported in *C. atrox*, but we are not able to say that this is the norm, nor are we able to say that this occurs throughout the entire range of the species. Clearly, this is one of the aspects of *C. atrox* that demands additional field work. Nevertheless, Berlandier was certainly on the right track, as he also was when he mentioned that young are born alive and that "they endeavor to bite as soon as they are born." The fangs, though small, are certainly not feeble, and are quite capable of killing rodent prey and envenomating humans. Berlandier's estimates of litter size were considerably high, as the range of litter sizes reported in the literature is from 4 to 25 ($\bar{x} = 10.6$).

The section on "fascination" is wonderful, partly because Berlandier showed us that he could be critical in dealing with anecdotes as well as observations of his own, and partly because he came so very close to identifying immobility as a defense of birds and small mammals against predation by snakes.

He was certainly correct about roadrunners and road guarders (*Drymarchon*) as predators of young *C. atrox*; but, there are other predators as well. Furthermore, although the road guarder discussed by Berlandier rejected the *C. atrox* it had killed, we are aware of other reports indicating that *Drymarchon corais* and *Lampropeltis getula* ingest young *C. atrox* unhesitatingly. The black rope story was charming, but a tad overstated.

The final section was reasonably accurate and based on some systematic data, showing that when Berlandier took the time to apply appropriate methodologies (in this case, dissection) and to make careful observations, he was capable of making real progress and of dismissing foolish folk beliefs. Several important papers on fang succession had already appeared in the literature (Mead, 1745; Knox, 1826), but Berlandier could not have known about them. He very likely was the first in North America to become independently aware of fang succession.

Acknowledgment

We are much indebted to Michael Dloogatch for editorial assistance.

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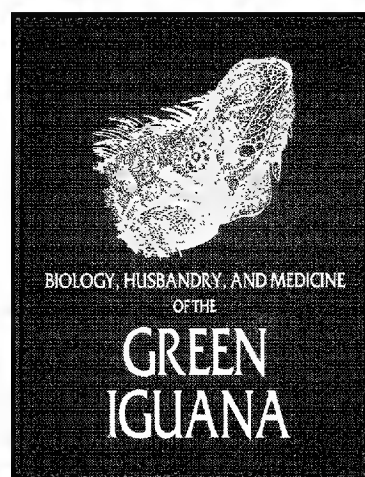
**Book Review: *Biology, Husbandry, and Medicine of the Green Iguana*
edited by Elliott R. Jacobson. 2003. Malabar, Florida: Krieger Publishing Company
xiv + 188 pp. ISBN: 1-57524-065-3. \$46.50***

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Biology, Husbandry, and Medicine of the Green Iguana is a text with multiple authors edited by Elliott Jacobson, one of the most eminent herpetological veterinarians in the world. Information on green iguanas is available from a variety of books, journals, conference proceedings and web sites, and is aimed at a variety of target audiences, namely keepers, biologists and veterinarians. Unfortunately, while topics of interest to these different groups often overlap, many references are not uniformly available to each of the groups. For instance, private keepers may not have access to professional herpetological journals, and veterinarians in mainly dog and cat practices may not have access to journals and proceedings on zoo, wild animal and herpetological medicine. Moreover, new information is constantly available and publications just a few years old often contain outdated information. Jacobson's text summarizes the current husbandry, biological and medical literature and also contains previously unpublished information by many of the authors.

Ten chapters are evenly divided between topics relating to biology and husbandry and those covering medical care. Each chapter is written by one or more expert in that field and relates both extensive literature summaries and personal research, experience and opinion. As a result, writing styles vary from



chapter to chapter and authors occasionally disagree with one another. In fact, in her chapter, "Infectious and Noninfectious Diseases," Lara Maxwell writes: "The veterinary literature directly pertaining to green iguanas tends to be somewhat contradictory as the experiences of many individual practitioners contribute to a general understanding of clinical diseases." Each chapter has an extensive reference list, averaging over 81 references per chapter (23–160). These lists will prove useful to readers requiring more information. However in their chapter, "Nutrition in Captivity," Mary Allen and Olav Oftedal note: "Unfortunately some assertions have been repeated so frequently, despite a lack of rigorous evidence, that they are widely accepted and form the basis for dietary recommendations and clinical therapies." The authors do a good job of differentiating between valid scientific research and anecdotal reports, and when relying on the latter, noting both the rationale behind the report and its potential weaknesses.

"Biology and Reproduction in the Wild" is a thorough summary by field biologist Gordon Rodda. Topics include systematics, distribution, size, sexual dimorphism, population biology, survivorship, longevity, time budget, thermoregulation, home range, dominance and spacing, reproductive physiology, reproductive behavior, and growth and development. Extensive, specific data is reported and is supported by the largest reference list of any chapter. Successful captive care of any reptile begins with a thorough understanding of requirements and normal parameters in the wild. This chapter contains a lot of data that will be useful to keepers but until now

has not been easily obtained by them. “Ontogeny of Captive and Wild Iguanas: From Emergence to Mating,” by Allison Alberts, Nancy Pratt-Hawkes and John Phillips, summarizes the “morphological, hormonal, and behavioral changes that characterize the developmental process . . . from hatching to adulthood.” Since so many iguanas are sold as neonates, this information is important to captive iguana husbandry. David Baer discusses “Nutrition in the Wild,” concluding that the iguana is “considered strictly herbivorous and based on analysis of stomach contents and feeding observations, is primarily folivorous (eating mainly leaves) . . . even hatchling and juvenile green iguanas appear to be herbivorous . . . [although] there are sporadic reports of individual adult iguanas eating atypical feedstuffs such as animal or insect matter.” He covers the anatomy and physiology of the digestive tract, microbial fermentation and the relationship between temperature and digestion. Allen and Oftedal cover “Nutrition in Captivity,” discussing salad-based diets and commercial diets, protein requirements for growth, the relationship between high protein levels and gout (which has been reported but not substantiated), fiber, metabolic bone disease, the fact that diet cannot provide sufficient vitamin D (and thus the importance of UV light) and other nutrients of concern. Analysis of 31 commercial iguana diets found only two — neither of which is sold in pet stores — that met reported nutrient standards for juvenile and subadults and an additional five diets that met lower protein standards for subadults. It is unknown whether vitamin and trace mineral levels were sufficient in any of these diets. Vitamin and mineral supplementation is discussed, along with a list of 19 specific recommendations for captive iguana nutrition. “Husbandry and Management” is the topic most covered in iguana books available to the public, but Schumacher, Köhler, Maxwell, Antonio and Ehrig do a good job of summarizing the pertinent literature, supplemented with their broad experience. The usual topics are discussed, such as temperature, humidity, natural sunlight, quarantine, disinfection and caging. The authors also cover shift cages, outdoor enclosures with underground bunkers, roofs and shade, mist systems and social compatibility. Diet is discussed, with reference to the previous chapter for more information, but a recipe for a salad-based diet is included. Captive reproduction rounds out the chapter.

The veterinary chapters begin with “Clinical Evaluation and Diagnostic Techniques” by Jacobson himself. History, physical examination, hematology, biopsy, microbiology and fecal examinations are discussed in his usual thorough, clear and accurate style. Jacobson draws on his extensive experience and exhaustive knowledge of the literature. Normal hematologic and plasma biochemistry values, some of which were previously unpublished, are presented here. Maxwell discusses “Infectious and Noninfectious Diseases” and, with Kelly Helmick, “Drug Dosages and Chemotherapeutics.” In the former she covers viral, bacterial, fungal and parasitic diseases, neoplasia, and nutritional, reproductive, gastrointestinal and environmental diseases. Stress and anorexia are also mentioned. In the latter chapter, considerations in treatment are explained, including temperature, granulomatous inflammation, routes of administration, and the renal portal system. The topics that fill the majority of the chapter are fluid therapy, antibiotics, anti-

fungals, parasiticides, nutritional supplements, hormones, diuretics, gout therapies, and the limitations of metabolic scaling. A formulary is included. Brad Lock and Avery Bennett do a nice job discussing “Anesthesia and Surgery,” including principles, common procedures, and both soft tissue and orthopedic surgeries. The final chapter is “Diagnostic Imaging” by Susan Newell and Gregory Roberts. It focuses on radiology, with discussions of ultrasonography and other modalities.

There are 16 pages of color plates in the center of the book. Overall, the photos are sharp and clear and depict their subjects adequately. However, each page has six or seven individual photographs, with one page showing five images and two more showing eight. The result is that individual images are small and details are sometimes indistinct. Plate 1.4A, 5.12 and 5.13 have distinct bluish casts, plates 5.4 and 5.14 are unnaturally red, and plate 7.11 is too green. Plates 6.1, 6.9, 7.4, and 7.10 have excessively narrow depth of field, making parts of the subject blurry. Digital image manipulation software is widely available, so there is no excuse for less than perfect photographs. Plates 6.9 and 9.24 are repetitive, both showing regenerated tails. There are many useful tables and a few graphs within the text, but few figures. “Nutrition in Captivity” depicts a single radiograph and a single photomicrograph, while “Anesthesia and Surgery” has a single line drawing describing suture placement. “Diagnostic Imaging” has the most figures by far with 28. Unfortunately these also are small in size. Because they are radiographic and ultrasonographic images, they tend to be dark with low contrast making it difficult to perceive details. Publishers often struggle to produce quality images of radiographs and ultrasonographs, but it can be done. Another criticism of the diagnostic imaging figures is the lack of reference arrows, which are used to good effect in the color plates. Figures 10.7A and 10.15 depict, respectively, a “gecko” and a “monitor lizard.” The common and scientific names should have been provided. No doubt the large number of images per page, small image size and low number of figures in the text was chosen to help keep the cost of the book low, and this is a very reasonably priced book.

This book will be useful to keepers, biologists and veterinarians who work with green iguanas, and anyone with deep interest in this species. While husbandry advice for keepers is available from a variety of sources, this text has a more scientific approach — as opposed to being based on personal opinion — compared to most. The information also is the most up to date in any book. Nevertheless, half of the book is devoted to technical veterinary topics that won’t be put to use by non-veterinarians, but may be of interest to serious hobbyists and biologists. This is a scientific text, and as such uses scientific terminology throughout. Specific references within this review serve as examples of just how technical many topics are. Readers not versed in biology, taxonomy, population dynamics, nutrition, anatomy, medicine, surgery and pharmacology are likely to run across unfamiliar terms. In accordance with the succinct, synoptic style of the book it lacks a glossary, as might be found in a text on biology or herpetology. It does, however, have an index.

The text is extremely succinct, with each topic mentioned

only once in the book. For instance, salmonellosis and its potential spread to keepers are discussed in the “Infectious and Noninfectious Disease” chapter, but that discussion is only referred to in the “Husbandry and Management” chapter. Likewise assist- and force-feeding is discussed at some length under Stress, Disease and Anorexia in the “Infectious and Noninfectious Disease” chapter, but is not mentioned in the “Nutrition in Captivity” chapter. Certain medical techniques are recommended, such as external skeletal fixation devices for fractured limbs and antibiotic-impregnated polymethyl methacrylate beads for septic arthritis, without describing specifically how to implement such techniques. Instead, readers are referred to other sources for that information. Medications are recommended for various diseases in the “Infectious and Noninfectious Disease” chapter, but the reader must go to the “Drug Dosages and Therapeutics” chapter to get dosages. The result is a compact text only 188 pages long. However, full comprehension of various material requires some paging back and forth. Because each subject appears only once, locating specific information within the text may require more effort for people new to the topics of iguanas, reptile medicine and reptile husbandry.

There are a number of subjects pertaining to iguana husbandry and nutrition that certain authors of other books treat with an authoritative and almost dogmatic style, but without the data to back them up. This book covers those same topics but refers primarily to scientific studies. For instance, several prominent authors still recommend animal protein in the diet of this herbivorous species. Schumacher et al. point out, “In captivity, the iguana’s instinct is not reliable. This may lead to problems since unnatural foods such as animal protein may be eaten if offered. Food items accepted by green iguanas in captivity range from french fries, pudding, and layer cake to dog and cat food. Obviously these items neither meet nutritional requirements nor are they suited for the fermentative digestive system of green iguanas. Acute problems such as bloat, as well as chronic diseases such as gout, hepatic lipidoses, renal disease, and arteriosclerosis, can result from improper feeding.” Maxwell states that “an excessive amount or the incorrect type of dietary protein, such as animal protein fed to herbivores, can result in gout.” Allen and Oftedal observe that the situation is complex. They point out that even though the main waste product from protein catabolism is uric acid, the ionic form of which circulates in the blood as urates, no controlled studies have shown high protein intake to directly cause visceral gout in reptiles. Amino acid deficiency and imbalance, renal insufficiency and dehydration also play a considerable role in this disease. Clearly different authors have differing viewpoints on certain subjects, nevertheless it is valuable to hear all of those viewpoints and the rationale behind them. As another example, many authors cite that certain plants contain oxalates and goitrogens, and conclude that these items should be avoided in the diet at all costs no matter what. Allen and Oftedal spend an entire two-column page describing the effects of these chemicals on humans and studied animals, the chemical and physiological effects observed, the different susceptibility to these chemicals between species, the lack of specific data in green iguanas, the role of vitamin C as a pre-

cursor to oxalic acid, lists of plant species with high and moderate levels of oxalates, the role of glucosinilates in goiter formation in mammals, the plants that contain glucosinilates, the lack of evidence that hypothyroidism or goiter, both of which are reported in some species of reptiles, is caused by ingestion of these plants in reptiles, and the fact that such plants are routinely used as part of the diet (but not the sole diet) without causing symptoms in green iguanas.

Many veterinarians recommend treating any parasite found on a fecal examination. Maxwell points out that many protozoans and oxyuroid nematodes are normal gut inhabitants that serve as commensal or mutualistic parasites in iguanas. Many iguana books recommend treating all cases of oxyuroid nematodes in iguanas based on a single report of the death of a Fiji Island iguana, *Brachylophus fasciatus*, from impaction with oxyuroid nematodes. Maxwell notes that the species of nematode in that case was not one found in green iguanas, and that the affected individual was wild-caught with a history of failure to thrive in captivity, suggesting that other factors were involved in the death.

Deficiencies in the text are few, and more often the result of omission than commission. Others simply reflect stylistic differences. The term preferred optimum temperature zone (POTZ) is commonly used in veterinary and husbandry literature, and is used throughout much of this text. The exception is Lock and Bennett, who use the term optimal temperature range in their chapter. The term POTZ is not commonly used in herpetological literature because it is an artificial combination of two concepts. The preferred temperature is that which a reptile chooses – a choice based on behavioral variables – while the optimal temperature is that at which physiological processes are optimized – a physiological constant. One is a choice, the other a constant, and so to lump them together is somewhat artificial.

Maxwell discusses the treatment of renal failure, and mentions that once plasma phosphorus levels have dropped, calcium can be administered. She doesn’t report what phosphorus level should be reached (normal?) or why calcium should be withheld with elevated serum phosphorus (the formation of insoluble complexes?) or whether those concerns have been documented in reptiles. She goes on to suggest the use of the diuretic furosemide in oliguric or anuric acute renal failure. However, elsewhere she notes that furosemide acts on the loop of Henle in the kidney affecting the resorption of sodium, and because reptile kidneys lack a loop of Henle the effect of furosemide is unknown. She also suggests that furosemide decreases excretion of uric acid in mammals, and because elevated uric acid levels are often present in kidney failure, its use may be contraindicated in this disease, seeming to contradict her earlier advice. Maxwell and Helmick describe placing intravenous catheters, stating that the ventral abdominal vein “is superficial to the coelom and can be reached without dissection through muscle tissues (Plate 8.4).” Plate 8.4 shows an anesthetized iguana with a huge bandage from armpit to groin, and no anatomical landmarks depicting the position of the ventral abdominal vein are visible. In fact, this vein is within the coelomic cavity, deep to the abdominal muscular wall, as

shown in Plate 9.4. To catheterize this vessel requires penetration of the abdominal wall; to do so without dissection would require a blind stick through the abdominal wall. The vein is attached to the abdominal wall by a mesovasorum or suspensory ligament and therefore is not always directly on the midline, making a blind stick less than a sure thing.

Lock and Bennett report that some surgeons prefer to wait until the next ecdysis to remove sutures, when wound strength would be increased as a result of proliferation of the stratum germanativum. However, Rodda reports several references stating that iguanas shed only once a year in the wild. The former advice is likely based on other species of reptiles that shed more frequently; obviously, sutures should not be left in for many months while waiting for the next shed in an iguana.

One example of omission is the condition of seminal plugs in male iguanas. This is a disease in which the inverted hemipenes become distended with a waxy secretion. It appears as bilateral swelling at the base of the tail and often the ends of the plugs protrude from the vent. In his "Clinical Evaluation" chapter Jacobson mentions "impacted hemipenes at the base of the tail" as something to look for, but there is no other mention in the book of diagnosis or treatment. Veterinarians and keepers see this condition with some regularity. Another omission occurs in the Digestive System section of the "Diagnostic Imaging" chapter, which mentions gas-filled bowel loops associated with intestinal obstruction due to ingestion of foreign objects. It fails to mention that gas-filled bowel loops are also

seen with ileus associated with idiopathic bloat and hypocalcemia and metabolic bone disease, in the absence of gastrointestinal obstruction. In the Genitourinary System section there is no mention that the testes can be visible on survey radiographs and could be mistaken for kidneys by persons unfamiliar with iguana anatomy.

New information is constantly available, and there is generally a lag time of one to two years between the submission of manuscripts and the shipping of a finished textbook. As a result every book will omit the latest information. Examples in Jacobson include the "Anesthesia and Surgery Chapter" failing to mention a new and commonly used gas anesthetic, sevoflurane. Maxwell and Helmick describe fenbendazole (Panacur) as appearing to be "safe and effective in treating nematode parasites in reptiles, with better activity than Ivermectin and no obvious side effects." Nevertheless, there was a report (Alvarado et al., 2001) describing the death of four Fea's vipers from an overdose of fenbendazole, although it probably appeared after Maxwell and Helmick's manuscript was submitted.

Each of these criticisms reflect a minor, specific point. Overall, Jacobson is a quality book with by far the best, most up to date, most accurate and scientific information on green iguanas available. Iguana keepers will find the book technical but useful, while it may be of more direct use to biologists and veterinarians. It is an exceptional value for the price. It is simply the best book on green iguanas available today.

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Bull. Chicago Herp. Soc. 38(7):145, 2003

Errata: Norman, B. R., A New Geographical Record for the Introduced House Gecko, *Hemidactylus frenatus*, at Cabo San Lucas, Baja California Sur, Mexico, with Notes on Other Species Observed

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Please note the following changes in the above-mentioned article [Bull. Chicago Herp. Soc. 38(5):98-100]. All places where it occurs in Table 1 "Todos San Lucas" should be "Todos Santos," and in the "Additional Observations" section "San Maria Beach" should be "Bahia Santa Maria."

Book Review: *Late Cenozoic Amphibians and Reptiles of the East European Plain* by Viatcheslav Ratnikov. 2002. Trudy Institute, Voronezh, Russia. Volume 10. 138 pp. In Russian with English Abstract. Softcover. ISSN 1608-5833. Order by ISSN number.

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Dr. Viatcheslav Ratnikov (Geological Faculty, Voronezh State University, University Square 1, Voronezh 394693, Russia; E-mail: gfkig210@main.vsu.ru) has been actively publishing on the Pliocene and Pleistocene paleoherpetology of Russia since the late 1980s. The above publication is his most significant one, as it attempts to solidify his arguments against the concept of the evolutionary stability of the European herpetofauna during the Late Cenozoic (e.g., Böhme, 1976; Gleed-Owen, 2000; Holman, 1998, 1999; Rage, 1974; Sanchiz, 1998). More specifically, it purports to give “proofs” of herpetofaunal changes during the Pleistocene. Since these interpretations are at odds with almost all current studies of Late Cenozoic herpetofaunas in the Northern Hemisphere, Ratnikov’s work deserves the attention of the herpetological community.

The book is divided into eight Chapters. Chapter 1 outlines the materials and methods of the study. A dot map indicates the fossil localities detailed. The next four chapters deal with the description of the osteology of 66 modern and extinct amphibians and reptiles, both species and subspecies. Chapter 2 covers the Anura (Discoglossidae, Pelobatidae, Palaeobatrachidae, Bufonidae, Ranidae, and those of uncertain relationships). Palaeobatrachidae is the only presently recognized extinct family of the Anura, and the presence of this unique family in the Pleistocene of Europe has always been considered of great interest. Palaeobatrachids are considered to be permanently aquatic frogs that are *Xenopus*-like in their habits. Chapter 3 covers the Salamanders (Hynobiidae, Proteidae and Salamandridae). Chapter 4 presents the Lizards (Varanidae, Anguidae, Lacertidae and lizards of uncertain relationships). Finally, Chapter 5 deals with the snakes (Boidae [Erycinae], Colubridae [Colubrinae, Natricinae], and the Viperidae). All of the illustrations of the amphibian and reptile fossils of these chapters are black and white line drawings. Most of these

drawings are much less detailed than the ones found in other European and North American accounts of Late Cenozoic amphibians and reptiles.

Chapter 6 is involved with paleogeographical reconstructions in the Late Cenozoic of Eastern Europe based on amphibians and reptiles. Two very small maps (in Fig. 6, p. 86) contain twenty-four crisscrossing lines that represent both geographic boundaries and individual taxa. These lines are poorly distinguished from one another, thus the data presented are either difficult or almost impossible to interpret. Chapter 7 consists of systematic lists of the herpetofaunas of the 91 fossil sites of the study, with the “characteristics” of each fauna given. Chapter 8 deals with five “stages of evolution” of the herpetofauna of the East European Plain. These stages are mainly based on traditional considerations of (1) extinct taxa, (2) modern taxa that do not presently occur in the area of the specific fossil locality and (3) modern taxa that presently occur in the area of the specific fossil locality.

My problem with these putative “stages of evolution” is that they are based, in many cases, on the identification of small samples of often fragmentary fossils. I have special concerns regarding the extinct taxa and suggest that the following ones in Ratnikov (2002) should be re-examined on the basis of better fossil evidence: ANURA - *Latonia* sp., *Ranomorphus similis*, *Pelobates fuscus dispar*, *Eopelobates* sp., *Bufo belogoricus*, *Bufo planus*, *Bufo albus*, *Rana shechmaniensis*, *Rana yalpuigiensis*, *Novooskolia cristata*, *Liventsovia jucunda* and *Negatchevia donensis*; SALAMANDERS - *Mio-proteus* sp. Another cloudy issue is that fact that Ratnikov recognizes seven colubrid snakes that are identified only as “seperate forms A–G”. If the colubrid forms are specifically identified later, it seems possible that Ratnikov’s interpretations might change.

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HerPET-POURRI

by Ellin Beltz

Hot breaking taxonomy news

Taxonomy is usually about as exciting as watching people argue about watching paint dry, but every once in a while, there's a great story from the dusty halls of academe. Realize that there are huge academic brownie points for naming new species and even greater species envy for those who have new critters named for them. And, of course, you can't really name a species for yourself, can you?

In this case, first it was one, then two, then nearly a dozen new species of freshwater turtles and land tortoises from Southeast Asia and China. Unlike most new species, these weren't caught in some pristine natural habitat heretofore untrammelled by western academics; rather 10 of these were bought from two reptile dealers who claimed to have acquired them in remote villages. The species descriptions were published from 1987 to 1997; the describers include a who's who in the turtle world and usually as co-author William McCord, a New York veterinarian, who actually bought the turtles from the dealers. The apparent rarity of most of the species resulted in four being included in the *China Red Data Book of Endangered Animals*. Turtles are in big trouble in Asia where zooming human populations with a taste for "bush meat" results in harvest pressures on the 90 or so species of native turtles. About 70 species are endangered. The dealers who supplied the exciting new turtles were Anson Wong from Penang, Malaysia and Oscar Shiu from Hong Kong. If these names sound familiar, the former is now in a U.S. prison for six years on a smuggling conviction. Federal agents are now attempting to extradite Mr. Shiu from Hong Kong because of his animal shipments into the U.S. Dr. McCord has continued to publish on specimens provided by the two men even as charges were filed and convictions obtained.

The plot thickens as James Parnum, a graduate student who describes himself as "just a guy working on fossils" began to have suspicions as to the identity of the new Asian turtles. The graduate student made repeated trips to China and teamed up with a local researcher. They visited turtle farms and discovered that some of the turtles described as "new species" were really hybrids bred for sale as medicine, food and for collectors. Turtle farmers freely admitted selling hybrid turtles to the dealers.

Two papers were published in 2001 suggesting that two of the "new species" were hybrids. An independent German group did genetic analysis and added a third to hybrid status. In the final shakeout, it appears that six "new species" are probably hybrids from captivity:

Mauremys iversoni
Mauremys pritchardi
Cuora serrata
Sacalia pseudocellata
Ocadia glyphistoma and
Ocadia phillippeni.

Three are species previously named:

Cuora chriskarannarum (sunk) = *Cuora pani*
Cuora pallidicephala (sunk) = *Cuora zhoui* and
Cyclemys atripons (sunk) = *Cyclemys pulchristriata*.

Which leaves only one that is actually a new species. Curiously it is named *Cuora mccordi* Ernst, 1988, for the veterinarian with the big turtle collection. Embarrassed coauthors and other researchers point out all this effort and money could have better been spent conserving real species from Asia—75 percent of whom could really use the help. [*Nature News* Feature: Mock Turtles, Volume 423, May 15, 2003, from Mike Dloogatch] Several years ago, a CHS member who shall remain nameless, spent a fortune on two "new species of turtle from Korea." When the box arrived, it was opened with great ceremony and the two "new species of turtle from Korea" were found to be red-eared sliders. Yes they were new to Korea in that their parents had only lived there a few years. No they weren't "new species," nor were they worth what was paid for them except as a reminder that things which seem too good to be true usually are.

Wait til he grows up

A ten-year-old Crystal Lake boy has been named Youth conservationist of the Year by the Illinois Audubon Society. Henry Cilley "and classmates at Glacier Ridge elementary School wrote letters and collected hundreds of petition signatures against the development [which would have damaged] a colony of about 70 turtles." Blanding's turtles are listed on the Illinois endangered species list. The developer brought in sand for new nests around the marsh, and installed retaining walls for the turtles after the protest. [*Chicago Tribune*, April 13, 2003]

You are what you eat

Hong Kong researchers discovered the SARS virus in three species of small mammals including civet cats which are eaten in China as a delicacy. A caveat noted that this discovery does not prove that this is how SARS entered the human population. [*Chicago Tribune*, May 24, 2003, from Ray Boldt] Meanwhile huge floods swept through the part of China where SARS seems to have originated, fortunately none seems to have been swept downstream by the floodwaters as feared at the time. [*Honolulu Advertiser*, May 17, 2003, from Ms. G. E. Chow]

Or perhaps what eats you

West Nile Virus is proving to be a potent pathogen, affecting not only birds and wild animals, but transferring to humans with occasionally fatal results. The alligators that died last year were described as sinking "into neurological meltdown" before death. Some had crawled in circles and others were wobbly. By March 2003 the disease had reached the Caribbean as well as southern California. The mortality rates among animals are described as similar to those in humans when diseases were suddenly transported across the Atlantic from 1492 to about 1650. The first U.S. outbreak was in 1999 when there were 62 severe cases and 2 deaths in New York. In 2000, 66 severe cases and 9 deaths, but spread all over the eastern U.S. In 2003 in the US, 2,350 cases were reported. Of those, 125 or 4 percent died. Wildlife mortality, however runs 30, 50, 70 and even an incredible 100 percent in crows. The virus was first recognized in 1937 in the West Nile region in Uganda. It is part of the disease family that includes Japanese and St. Louis forms of encephalitis. The infecting agent

is the obvious mosquito, but also 3 cases began with blood transfusions and one baby got it in breast milk. A different baby may have been infected in utero. By October 2003, West Nile had been documented in 32 states and the capital in people and in 186 different species of birds and 17 other vertebrates. So far, no reports of amphibian or reptile infection. Unlike SARS which doesn't seem to transmit to animals, West Nile is probably in North America to stay because common birds like house sparrows, blue jays and crows can get the disease by eating something tainted or by being bitten by a mosquito. So far, no West Nile has been found in migrating birds, but researchers do not know why not. And, fortunately the disease hasn't hit Hawai'i. Endangered Hawaiian crows (only 39 left) face "grim prospects if the disease hits." The U.S. Post office has stopped shipping live poultry and other live birds to the islands in an effort to slow the arrival of the virus. [*Science News*, March 29, 2003, from Marty Marcus]

Arrivaderci arribada!

"The toll on leatherback turtles from fishing is reflected on the protected beach here, where tourists and researchers — not to mention poachers — used to have a hard time navigating the beach at night without stumbling over one of the table sized beasts digging holes. Now leatherbacks are an unusual sight." By tracking turtles with satellite tags, researchers found that Mexican and Costa Rican leatherbacks swam around the Galapagos Islands right into drift nets off the coasts of Peru and Chile. Estimates of the kill are from two to three thousand every year from 1982 to the mid-1990s. Gill nets more than one mile long were banned by the United Nations, but smaller ones can and do kill sea turtles. And the big nets were just replaced with long lines with their concurrent kill of all species of sea turtles. [*Honolulu Advertiser*, from Ms. G. E. Chow]

Ova and ova now over?

A Palm Beach County, Florida, man who was caught with a stash of 324 sea turtle eggs in his truck was sentenced to 43 months in a federal prison. He had prior convictions, but is the first sea turtle egg poacher convicted in 20 years in Florida according to their Fish and Wildlife Conservation Commission. [*Orlando Sentinel*, March 9, 2003] In response to so much smuggling of sea turtle eggs, a Florida legislator introduced a bill to toughen up penalties which already include up to five years in federal prison and \$250,000 in fines. The new bill proposed making it a felony to have 12 or more eggs which rather begs the question of why number one through eleven don't matter. [*Arkansas Democrat-Gazette*, April 5, 2003, both from Bill Burnett]

Indestructible Worms and Giant Squid

- Searchers found a canister from the Columbia space shuttle on the ground three months after the crash. When opened it was found to contain live "*Caenorhabditis elegans*" described as a "tiny soil worm" which had been used in experiments on board the ill-fated spaceship. The *New York Times* speculates, "Whether this was mostly luck . . . or because of the worm's hardiness, is not clear. Their survival lends plausibility to the notion that life might have descended on Earth from other worlds in ancient times." [May 7, 2003, from Isadora Jarr]
- Antarctic fishermen have caught a "colossal squid with eyes

as big as dinner plates and razor-sharp hook on its tentacles," according to the *Chicago Tribune*. The "young female" squid weighed 330 pounds and was 16 feet long. Researchers point out that the "adults are much bigger." [April 4, 2003, from Ray Boldt]

Deja vu all over again

From the February 15, 2003, *South Bend Tribune*: "Humane Society raids home: Alligator, [2] pythons, [10] pit bulls [and a tortoise] removed." The gator weighed about 50 pounds and is between 4 and 5 feet with a temperament best described as "mean" by an Humane Officer. Last year a foot-long alligator was confiscated from the same home; at that time, its owner claimed not to know that keeping gators as pets is illegal in St. Joseph County, Indiana. [from Garrett Kazmierski]

Seven pounds for five dollars

Formerly quite safe in high waterfalls deep in the trackless jungles of West Africa, the goliath frog, *Conraua goliath*, is now being caught and sold for about \$5 per frog as food. Around half of their original habitat is lost, destroyed, changed, modified or poisoned. The other half is only lightly affected so far, but logging gives access to areas once pristine. Captive breeding in the U.S. and Europe never quite got off the ground and the animals are rarely seen in the pet trade. [*National Geographic*, June 2003, from Ray Boldt]

M*A*SSSSSH*

In Afghanistan it was sand vipers or some such, now the *Tacoma News Tribune* reports that large black snakes are being found in the 62nd Medical Brigade headquarters camp in Baghdad. Researchers speculate they are *Walterinnesia aegyptica*, described as "big, black, slithery and neurotoxic." [May 12, 2003, from Marty Marcus]

"Frog-odendron?"

Researchers inserted genes from *Xenopus laevis*, the African clawed frog, into rhododendrons to provide the plants additional resistance to root-rot fungus. The U.S. government has yet to approve any commercial process which inserts animal DNA into plants. [*EcoNews*, May 2003, from Brad Norman]

If it bleeds, it leads

A reporter from the *South Bend Tribune* interviewed a Michigan couple about their snake-killing dog named after the late Gracie Allen for her frantic antics. According to the article the owner would prefer that Gracie not kill or eat the snakes, but her excitement apparently takes her and her hapless victims to the point where any more information would just be thank you for sharing that. But they do. If you have to read it, dig up the back issue from March 21, 2003. [from Garrett Kazmierski]

Keys release me, let me go!

Residents of the Florida Keys are upset about a new invasive species, "dining on flower and vegetable gardens and freaking out the house pets. . . . Hundreds of iguanas are turning up all over the Keys." Residents are asking the Florida Game and Fish Commission to assess the impact of the hundreds or thousands of iguanas that are now apparently freely reproducing in the wild. Locals speculate they are breeding from parentals which were released by their owners after they stopped being

cute little baby lizards and turned into, well, iguanas. [*Miami Herald*, March 9, 2003, from Carla and Miguel Ochoa and Marty Marcus] Don't forget that abandoned giant snakes have taken up residence in the Everglades and geckos live in Ohio and Puerto Rican coqui frogs have invaded the Big Island of Hawai'i and . . . and . . . and . . .

Duh!

"Gila Monster Drool Cuts Appetite," reports the usually quite reliable *Wall Street Journal*. Apparently, it's a hormone found in the Gila monsters' saliva that can be used to make a drug that curbs diabetes and overeating. The article also calls Gilas "poisonous," when they really mean "venomous," but what can you expect from a press release that says since the drug would be made entirely in the company's labs that production of it "would have no environmental impact." Don't get all excited about drinking drool, the treatment requires multiple daily injections. And many of the volunteers reported upset stomachs and some even dropped out because of them. Or maybe someone just told them what it was made from. [June 17, 2003, from Mike Dloogatch]

Who's nuts?

The *Chicago Tribune* asks, "Why, in a nation blessed with an abundance of dogs, cats, goldfish and hamsters, would anyone choose to share their personal space with a . . ." As herp owners, I know you're expecting some kind of reptile, but the article is about people owning tigers, leopards, jaguars and cougars. Right now there are believed to be between five and ten thousand privately held big cats. For the next person who tells you keeping an amphibian or reptile is nuts, these tiger people are managing "to provide 10 pounds or so of meat a day, clean their cages and comply with the licensing requirements of the U.S. Department of Agriculture. All this, without getting mauled to death." [May 28, 2003, from Ray Boldt]

"Revenge of the snake on me"

A woman in Thailand was listed in critical after being bitten by a king cobra she believes was revenging the death of another cobra which she had taken for the stew pot the month before. The revenge idea was reinforced by the tale that the fangs would not come out of the victim until the head was cut off by other workers at the plantation. [*Honolulu Advertiser*, May 17, 2003, from Ms. G. E. Chow]

"Do you miss Chicago, much?"

According to a story attached to what Ray Boldt really wanted me to read that really rather answers the question posed above. "A test of surveillance cameras at two busy [Chicago] intersections documented more than 2,000 violations [running red lights] in three weeks. [*Chicago Tribune*, May 16, 2003]

Great career move

Seven years ago a young urban professional tried to smuggle 37 Madagascan tree boas into the U.S. at O'Hare International Airport. His case was finally brought forward and the U.S. attorney's office "could not say why it took seven years to file the charges, which it did in federal court in Chicago." The snakes were discovered in a suitcase and were estimated to be worth \$80,000 because they are endangered. [*Chicago Tribune*, June 1, 2003, from Ray Boldt]

Hog heaven

Islands in Lake Erie used to be the happy homes of the now Ohio endangered and federally threatened Lake Erie watersnake; however during the 19th century "the islands were swarming with snakes, so hogs were brought in to eat them" and "over the years, developers, islanders, boaters and tourists have added to the decimation" according to the *Cleveland Plain Dealer* [June 1, 2003]. [from *GreenLines* #1885, June 13, 2003] Curiously, hogs in western Illinois may have led to the decline and fall of massasauga populations according to local residents.

Clone alone

The Curator of Reptiles at the Artis Zoo in Amsterdam has announced finding that nearly 40 percent of his Burmese python's unhatched and unfertilized eggs "harbor tiny embryonic replicas. Several snake species are known to reproduce without sperm, a process known as parthenogenesis, though the phenomenon has never been documented in pythons. Stranger still, the embryos are all female, a first for parthenogenic snakes, whose chromosome setup typically produces males only. The Artis Zoo plans to hatch the eggs to see if they inherited [their mother's] cloning powers. Meanwhile, [she] is being kept far from any male: A single conjugal visit and 'the whole special thing would stop at once,'" the curator warned. [*HerpDigest* 3:41, from Allen Salzberg]

Unlucky 13

Even though his friends screamed at him to get out, a 12-year-old boy continued to swim in the Dead River near Tavares, Florida until an alligator grabbed him in his jaws and disappeared beneath the surface. Deputies and trappers rounded up all the gators over eight feet they could find to be sure they had captured the man eater. His companions said they had been seeing gators all day, but would just get out of the water when one was spotted. Florida has had only one dozen fatal gator attacks since records of such things began in 1948. The last one was in September, 2001. [*Chicago Tribune*, June 20, 2003, from Mike Dloogatch]

UK law grows teeth

One of the primary hubs in the global illegal trade in wildlife has increased its criminal penalties for the trading in endangered species. Jail terms in England now can be from two to five years. Illicit trading is now an automatic arrest and includes trade in materials made from endangered animals including Shadoosh shawls and various Oriental medicinals. The World Wildlife Foundation estimates that "hundreds of millions of plants and animals, worth billions of pounds were traded illegally each year, threatening the survival of many species such as tigers, snow leopards, bears and some plants," and the changes will "have a lasting impact for endangered species all over the world," [*GreenLines* #1886, June 14, 2003]

Thanks to everyone who contributed this month and to you, because you're about to send me a great clipping about reptiles, amphibians, animals or conservation issues. Aren't you? Mail whole pages of newspapers or magazines with your name on all the pieces in nice big envelopes (save on that Origami) to: Ellin Beltz, POB 934, Ferndale CA 95536.

Unofficial Minutes of the CHS Board Meeting, June 13, 2003

Lori King called the meeting to order at 7:40 P.M. Board members Tom Anton, Darin Croft, Linda Malawy, Joan Moore, Michael Redmer and Jenny Vollman were absent. A quorum was not present.

Officers' Reports

Recording Secretary: Zoe Magierek read the minutes from the May 16 meeting, which had been taken by Mike Dloogatch. Corrections were made and the minutes were accepted.

Treasurer: Jim Hoffman presented a balance sheet as of May 31. He pointed out that the adoptions program is doing well at raising money and covering its expenses.

Membership Secretary: The May mailing was 731. Mike Dloogatch mentioned reducing the print number to 800 if membership keeps dropping.

Corresponding Secretary: It was mentioned that the voicemail message lists certain people as contact who are no longer active members; Erik Williams will change the message. Erik Williams will become the new lizard contact. Many calls about turtles are referred to Ron Humbert.

Standing Committees

Raffle: Many good raffle items have come in; the letters Erik Williams wrote seem to be doing their job. Ron Humbert mentioned we have at least three months' worth.

Library: Mike Dloogatch mentioned that Steve Barten already has a copy of the book on iguana medicine that he is reviewing for us. The review copy we received will go to the library.

Conservation: Jack Schoenfelder will be doing a show at an animal rehabilitation center and was wondering if he could bring massassauga shirts to sell, and perhaps mark the price up a little to give the center a portion. It was decided that he should. Lori King spoke to Jim Nesci who will be donating some of his photo proceeds from ReptileFest to our conservation fund.

Animal of the Month: June is the Show and Tell meeting and July will be colorful herps. It was decided that August would be Illinois herps. Rich Crowley will be taking over the animal of the month program.

Ad Hoc Committees

Trips: The Indianapolis Zoo trip is scheduled for September 13. Jack Schoenfelder mentioned getting together with the Hoosier Herp Society when we are there.

Old Business

State Reptile/Amphibian: Ron Humbert has been giving many school talks and has over 750 names on the State Amphibian petition. It will be ready to go for a vote when school starts again. Steve Sullivan is working on the reptile end of things with the Chicago Public Schools.

Bylaws change: Lori King mentioned that we have to take a vote on a change in the bylaws at the next general meeting. Ron Humbert wanted to know what we were changing. Lori King explained how Joan Moore would like to be able to take a head count instead of recording the name of everyone who attends a meeting. It was brought up that the names were originally taken for a newsletter mailing that we no longer do.

Cricket Sales: Linda Malawy would like to make crickets available to members at meetings through The Bug Company. The profits would go to adoptions. Linda will take prepaid orders. Originally, she was going to have members write checks to her for the crickets and she would pay with her own credit card. Mike Dloogatch brought up that it looked unprofessional for the checks to be written to her instead of to the CHS, since it is a CHS function. Jim Hoffman stated that this was his preference also, but he had told Linda that she could do it whatever way she felt most comfortable. It was decided that Linda should either get CHS checks or a cash advance to use to pay for the crickets. Jack Schoenfelder mentioned the issue of sales tax. It was decided that when we are liable for sales tax we would pay it. Jim Hoffman wondered if crickets were going to be sold only to members or to anyone who wanted to buy them? It was decided that the availability of crickets was a membership benefit. The issue of tax was brought up again and Lori King decided that before we make any broad decisions we should give the crickets sales a few months and see how they go and see what kind of profits and tax liabilities we are talking about. Jim Hoffman said that Linda wanted to send an announcement to the CHS E-mail list about the crickets.

Ron Humbert said that John Bailey would be taking over pop sales at general meetings.

PARC Contribution: Lori King received a letter about the CHS making a contribution to PARC for a state coordinator. Lori E-mailed them back and told them we would consider it. Mike Dloogatch pointed out several problems with the letter, and it was decided that much clarification was needed before we make a donation.

Suggestions

Jim Hoffman wants to get a rodent supplier to advertise in the *Bulletin* and perhaps offer a discount to members. They are interested, but he has had trouble contacting them further.

Jack Schoenfelder was wondering if we could do something as a society when schools or kids do something good for the environment or herps. Perhaps we could give them a year membership in the CHS? Betsy Davis mentioned that doing this publicly would be good publicity for the CHS.

Round Table

Lori King got an E-mail from the Louisiana Gulf Coast Herpetological Society asking us to help them oppose house bill #1468 in their state.

Jack Schoenfelder has bought a 50-pound bag of trout chow and

intends to sell it in small amounts with the proceeds going to the CHS. Jim Hoffman wants these proceeds to be recorded and tracked.

Ron Humbert still has four pairs of Pilstrom tongs left here by Dr. Pilstrom after ReptileFest. Jack Schoenfelder said that he might be able to help sell them if need be.

There are eight posters left from a poster rack that Jack ended

up with. Mike Dloogatch suggested they go to the raffle.

Lori King mentioned creating a new category in the minutes, General Meeting Sales.

The meeting was adjourned at 9:06 P.M.

Respectfully submitted by Recording Secretary Zoe Magierek

Advertisements

For sale: rats and mice —pinkies, fuzzies and adults. Quantity discounts. Please send a SASE for pricelist or call Bill Brant, *THE GOURMET RODENT*, 6115 SW 137th Avenue, Archer FL 32618, (352) 495-9024, E-mail: GrmtRodent@aol.com.

For sale: murine-pathogen-free rats and mice available in all sizes, live or frozen: pinkies, fuzzies, crawlers, small, medium and large. Frozen crawler mice in lots of 2000, \$.17 each. Also available, full grown hairless mice. FOB shipping point. Master Card accepted. Call (518) 537-2000 between 8:00 A.M. and 5:00 P.M. or write SAS Corporation, 273 Hover Avenue, Germantown NY 12526 for prices and additional information.

For sale: from **The Mouse Factory**, producing superior quality, frozen feeder mice and rats. We feed our colony a nutritionally balanced diet of rodent chow, formulated especially for us, and four types of natural whole grains and seeds. Mice starting from: pinks, \$.17 each; fuzzies, \$.24 each; hoppers, \$.30 each; weanling, \$.42; adult, \$.48. Rats: starting with pinks at \$.45 each, to XL at \$1.80 each. Discount prices available. We accept Visa, MC, Discover or money orders. P.O. Box 85, Alpine TX 79831. Call us **toll-free** at (800) 720-0076 or visit our website: <http://www.themousefactory.com>.

For sale: from Bayou Rodents, excellent quality feeder mice and rats. Every size available. Pinks starting at \$20/100. Orders are shipped by overnight service Monday thru Thursday. We accept Visa, MasterCard and Discover. For more info, contact Rhonda or Peggy, (800) 722-6102.

For sale: **high quality frozen feeders**. Over a decade of production and supply. Seven sizes of mice available: small newborn pinks up to jumbo adults. Prices start at \$25 per 100. Feeders are separate in the resealable bag, not frozen together. Low shipping rates. Free price list. Kelly Haller, 4236 SE 25th Street, Topeka KS 66605, (913) 234-3358 evenings and weekends.

For sale: **Pillstrom Snake Tongs** are available from the manufacturer and are shipped worldwide. Lengths/prices: 26"/\$58, 36"/\$59, 40"/\$60, 46"/\$61, 50"/\$62. Shipping and handling costs in the U.S.: \$8 for the first tong, \$1 for each additional. Pillstrom Tongs, 4617 Free Ferry Road, Fort Smith AR 72903-2363, (479) 452-3001 phone, (479) 452-3671 fax. E-mail: pillstromt@aol.com. Website <members.aol.com/mpillstrom>.

For sale: natural history books. *Reptiles of the Solomon Islands* by Michael McCoy, 1980, 80 pp., 20 color and b&w plates, 8 figs., keys, *Candoia*, *Corucia* and others, softbound, \$23; *Wildlife in Papua New Guinea* by Eric Lindgren, 1975, 94 pp., 193 excellent photos; 22 pp. on herps including photos and info on D'Albert's, Boelen's and green tree pythons and the emerald monitor, DJ, hardbound, \$35; *Birds of Colorado* by Bailey and Niedrach, 1965, 2 vols. (895 pp.); 124 color plates, many b&w photos, as new condition, hardbound, \$150; *Common Snakes of South East Asia and Hong Kong* by Reitingner and Lee, 1978, 114 pp. plus 31 color photos, drawings, regional distribution table, softbound, \$25; *Wildlife of the South Seas* by Roedelberger and Groschoff, 1967, 216 pp., numerous color and b&w photos, no DJ, Galapagos tortoises and Komodo dragon, among many other herps, hardbound, \$20. All books are in excellent condition. Postage free for orders \$25 or more; \$2.50 for orders less than \$25. Send E-mail address for complete book list. William R. Turner, 7395 S. Downing Circle West, Littleton, CO 80122, (720) 344-6197. E-mail: SMUparent@aol.com.

For sale: Jungle carpet pythons, captive bred hatchlings from beautiful black and yellow adults, \$75. Ralph, (847) 904-7229.

For sale: c.b.b. rough-scaled sandboas, born 7/1/03, excellent color, from large parents, \$50 each, will lower price for group. Scott Miller, (309) 833-1849; E-mail: erycine1@aol.com. [Macomb IL]

For sale: African house snake, *Lamprophis fuliginosus*, male, 18 months, red phase, \$35; African house snake, *L. fuliginosus*, female, 18 months, green phase, \$40. Or \$70 for the pair. E-mail Jim Hoffman at james-hoffman@attbi.com or call (847) 534-4980. Chicago area.

For sale: All of the following c.b. '03 garter snakes are now available. All are healthy, voluntarily feeding on feeder fish and mite free. **Easterns:** erythristic × melanistic × melanistic × erythristic, erythristic \$100, melanistic \$35; Super flames (erythristic/Blais flames × Erythristic/Blais flames) ?; Blais speckled flames \$125, Blais flames \$100, melanistic \$35 and Florida \$25 each / 2 for \$40. Plains: Red/anerythristic × red/anerythristic ?, Red/hypo × albino × red/hypo × albino ?; snows (Iowa and Nebraska strains), \$275; albinos from red × albino × red × albino, \$150; Iowa albino, \$100; Nebraska albino, \$100; anerythristic, \$50; quad het (Iowa snow × Nebraska snow), has genes for 4 traits, \$85; Nebraska albino × red albino, \$40; Christmas albino, \$200; super Christmas albino (Christmas albino × red albino) *special, \$300, females only/trios, \$600 (buy 2, get 1 free); possible hets, \$35; normals, \$25 each/2 for \$40. **Red Sideds:** albinos (limited number available), \$350, possible het albinos (66%), \$50, anerythristic, \$100, het anerythristic, \$50, possible het anerythristic (66%), \$35, normals, \$25 each/2 for \$40. **Wandering:** albino, \$150, hets, \$75, normals, \$25 ea/2 for \$40. **Florida "true" blue-striped (similis)** \$40–100. **Santa Cruz** (orange and yellow morphs), \$60; **California red-sided**, \$125. ? = Price is to be determined at birth. Inquire about quantity discounts. E-mail: SFelzergarters@nc.rr.com or call Scott, (919) 365-6120 EST. Web address: <http://www.thamnophis.com/features/ScottFelzer/>

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Wanted: We need a person who can assist in the care and maintenance of an extensive tortoise collection. Our primary concern is in having a dependable care-giver while we are gone on a few weekends per year but particularly while we travel for a week at a time 2 to 3 times per year. Must have a passion for animals and have a basic understanding of the environmental and dietary requirements of reptiles; tortoises and turtles especially. Far Northwest Suburb. We will train the right person. If you are or know of anyone who is responsible and dependable and has the interest in learning, please contact: Bob or Denise Krause, (847) 844-1328 or E-mail: robertk@superpet.net.

Wanted: I'm looking for my soulmate. I want to settle down to a family before it is too late. But I have this problem. . . . When we get into hobbies and interests: old popular records, jazz and show tunes, and antique electronics are fine, but when I mention turtles, "What, are you crazy?" So maybe this is a better place to look. Please don't try to separate me from my turtles—at least not most of them. If interested, please drop a line to Ellis Jones, 1000 Dell, Northbrook IL 60062, telling a bit about yourself and giving a phone number.

Wanted: big-headed turtles; mata mata turtles; Mexican giant mud turtles (*Staurotypus triporcatus*); exceptionally large common snappers (45 lbs. & up); large alligator snappers (over 90 lbs.); spectacled caiman from Trinidad, Tobago and Surinam; dwarf caiman; smooth-fronted caiman; albino turtles (except red-eared sliders). Walt Loose, (610) 926-6028, 9:00 A.M. – 1:00 P.M. or after 11:30 P.M. Eastern Time.

Line ads in this publication are run free for CHS members — \$2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to: Michael Dloogatch, 6048 N. Lawndale Avenue, Chicago IL 60659, (773) 588-0728 evening telephone, (312) 782-2868 fax, E-mail: <MADadder0@aol.com>.

News and Announcements

TENTH ANNUAL ARAV CONFERENCE

The 10th Annual Conference of the Association of Reptilian and Amphibian Veterinarians will be held October 4–9, 2003, at the Minneapolis Hyatt Regency Hotel, Minneapolis, Minnesota. For information or registration contact Dr. Wilbur Amand, P.O. Box 605, Chester Heights, PA 19017, (610) 358-9530, or ARAVETS@aol.com; web site: www.arav.org. You may also contact the program chair, Dr. Richard S. Funk, (480) 833-7330; azfunks@aol.com. Interested non-veterinarians may also register and attend.

INDIANAPOLIS ZOO TRIP

Join us on Saturday, September 13, for an adventure-filled day trip to the Indianapolis Zoo. Visit the Deserts Dome, where reptiles roam free in an artificial desert. See a special exhibit: "Drop Dead Gorgeous Snakes" (Learn more at www.indyzoo.com). Learn first-hand from zoo staff about their highly successful iguana breeding programs for Grand Cayman blue, Ricord's, Cuban ground and rhinoceros iguanas. This Zoo has also committed its financial and technical support for the endangered Jamaican iguana.

The CHS has arranged luxurious, washroom-equipped bus transportation, with movies-in-transit. We'll be leaving from the Peggy Notebaert Nature Museum at 7 A.M., returning before 10 P.M. So reserve the date. Seats are limited and will be available on a first-come-first-serve basis. We expect demand to exceed the available seats, so don't delay. Contact Bob Herman for details at (773) 667-4095 or by E-mail at bobherman@ameritech.net. Round-trip transportation with zoo admission is just \$30 per person! Children are welcome.



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UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, July 30, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. Speaking will be **Dr. Robert Powell**, Professor of Biology at Avila College in Kansas City, Missouri. His topic will be “The Anoles of Grenada—and Their Interactions with Other Reptiles.” Dr. Powell's research interests in recent years have focused primarily on Hispaniolan herpetofauna. Since 1986 he has made nearly 40 trips to the West Indies to study the life histories and community structure of the amphibians and reptiles. His emphasis has been on the anoline communities of those tropical and subtropical islands.

The regular monthly meetings of the Chicago Herpetological Society are held at Chicago's newest museum—the **Peggy Notebaert Nature Museum**. This beautiful new building is at Fullerton Parkway and Cannon Drive, directly across Fullerton from the Lincoln Park Zoo. Meetings are held the last Wednesday of each month, from 7:30 P.M. through 9:30 P.M. Parking is free on Cannon Drive. A plethora of CTA buses stop nearby.

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? If so, mark your calendar for the August 15 board meeting, to be held at the North Park Village Administration Building, 5801 North Pulaski Road, Chicago. To get there take the Edens Expressway, I-94, and exit at Peterson eastbound. Go a mile east to Pulaski, turn right and go south to the first traffic light. Turn left at the light into the North Park Village complex. At the entrance is a stop sign and a guardhouse. When you come to a second stop sign, the administration building is the large building ahead and to your left. There is a free parking lot behind the building.

The Chicago Turtle Club

The monthly meetings of the Chicago Turtle Club are informal; questions, children and animals are welcome. Meetings normally take place at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago. Parking is free. For more info call Lisa Koester, (773) 508-0034, or visit the CTC website: <http://www.geocities.com/~chicagoturtle>.

HERP OF THE MONTH



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